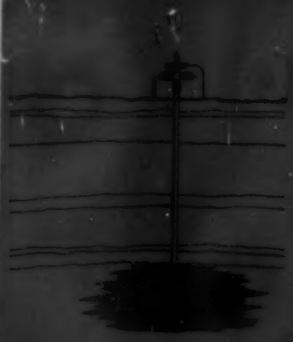
the OIL AND GAS JOURNAL

MAY 27, 1957

A. P. I. PIPELINE REPORT
P. 108



Journal's Survey Shows . . .

UNDERGROUND GAS STORAGE

- Big Business - Big Future - p. 88

NEW RECORDS in sight for IMPORTS p. 85

COMPLETE ROUNDUP ON

World's Most Modern Refinery

Facilities, processes, flow patterns—
Tidewater's new Delaware plant

40-page section starts p. 159

EAR TO THE AIR

To put modern communications at the service of oilmen everywhere, Halliburton maintains the world's biggest two-way industrial radio network, linking its trucks, autos, pickups, planes and ships to dispatching centers. In emergencies untold thousands of dollars have been saved for well owners by radio-directed Halliburton "rescues". Even more important, keeping an "ear to the air" for coordination of oil well service assignments means maximum convenience for Halliburton customers.

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"PROGRESS IN SERVICE THROUGH RESEARCH"

JOURNAL News Letter

May 27, 1957
Tulsa, Okla.

Oil men are looking at their hole cards in North Dakota:

One official predicts the state's oil future will be decided in the next 3 years. Leases taken in major plays between 1948 and 1950 will expire between now and 1960. Unless stepped-up wildcatting turns up more oil pools, the leases may be dropped.

Here's the hard fact behind the situation: The oil industry so far has invested more than $500 million in North Dakota. It has recovered only a fraction of that amount. One company -- Pan American Petroleum -- alone has spent $47 million in the Williston basin and $28 million in North Dakota. Total return: Only $1.1 million. On basis of North Dakota investment, it will take 60 years to recover Pan American's costs, not counting interest.

What's needed? More astute geological interpretation to pin-point oil traps the seismograph is unable to turn up and courage to drill a large number of tests.

SHY OF VOTES: There's more than apathy behind House leaders' reluctance to push the Harris-O'Hara natural-gas bill. A House poll shows that the bill right now couldn't get enough votes to pass. In fact, it's six votes shy. Support for the bill, meanwhile, is only lukewarm in the industry. Texas Independent Producers and Royalty Owners Association endorsed measure last week only if the offending amendments proposed by the Eisenhower administration are dropped.

NEW IDEA: Atlantic Refining has hit a manpower payoff with a new approach to recruiting for foreign service. Company needed quota of 20 engineers quickly for expanded operations in Venezuela. It sent its top Venezuelan drilling-production man and foreign personnel manager into Texas and Oklahoma. They were authorized to hire on the spot and arrange salaries.

Idea was to give prospective employes chance to talk and see their boss, get idea of the work, and size up the company. The result: The quota was overfilled. Atlantic hired more men than it intended because of superior quality and even had a chance to be a little choosey.

TALKS DRAG: At the rate Gordon Gray is talking with importers, it will be

midsummer before he knows just how far the 60 companies will go in voluntarily cutting imports. He has met with officials of a half dozen firms so far plus leaders of the I.P.A.A.

Gray is seeking an ideal plan to limit imports, according to inside reports. This will require neither formal governmental order nor antitrust immunity. He wants each company to limit its own imports without regard to what other companies are doing. In this way concerted action will be avoided and antitrust clearance unnecessary.

While these talks go on, reports to Texas Railroad Commission indicate importers plan to maintain imports at a rate exceeding a million barrels daily for the third quarter.

TANKERS: The supertankers are meeting physical obstacles that are trimming their economic advantage over smaller ships. Chief trouble: Too many channel and harbor facilities are too shallow and too narrow. Some of the very large ships coming to U.S. and South American ports spend as much as 6 days in the discharge port. This is due to need for lightering before moving to a discharge berth. Then the ships must wait favorable tidal and weather conditions to navigate over the bar and in restricted channels.

EXPLORATION: A sizeable offshore deal is being completed by the C.A.T.C. Group and Gulf Oil. C.A.T.C. is getting an option to acquire half interest in the 30,000-acre block in East Cameron area off the Louisiana coast. Gulf paid $7 million for the leases in 1954 and has hit two dry holes in the area since. The deal reportedly involves a drilling commitment by which C.A.T.C. can earn up to 50 per cent interest in the lease.

More leases on the outer Continental Shelf off Louisiana may be offered the oil industry before the end of the year. Interior Department officials are drawing up plans for a sale even if the Supreme Court does not decide the present boundary dispute before it recesses for the summer.

Gulf researchers are building miniature mountains with an unusual machine. Their object: To learn how nature builds mountains and foothills. They hope the payoff will be an easier method of recognizing strat traps in mountainous country and pinning down likely drilling sites.

A bill to permit leasing of Alaska's submerged lands for oil exploration is now before Congress. It is supported by territory officials and interested oil companies. Interior Department officials like the idea but think there should be two bills. One would apply the Mineral Leasing Act to the navigable waters. The other would subject the offshore area to provisions of the Outer Continental Shelf Act.

Skelly and Atlantic Refining have opened the first Spraberry limestone production in the Midland basin area of West Texas. The test, 1-S Texas, 8 miles northeast of Andrews, showed a potential of 221 bbl. daily after treatment with mud-acid.

FOREIGN NOTES: Another French discovery in the Algerian desert may be in the making. Reports in Paris say a 5-mile stepout north of the Hassi Messaoud strike also has encountered the productive sandstone updip

at 10,725 ft. The Hassi Messaoud well located the 450-ft. thick pay at about 11,500 ft. It was a 2,500-bbl. daily producer.

Plymouth Oil is negotiating for concession rights in French West Africa and in Guatemala. It's the firm's first move off the North American continent .... Sun Oil has acquired half interest in a 750,000-acre concession in Colombia from Mobil Oil of Colombia and International Petroleum. Deal calls for Sun to drill two 9,500-ft. wildcats to earn an interest. In the deal with Sun are Pure Oil and United Carbon... Bolivian Gulf plans first deep test on a 3,750,000-acre concession in northern Bolivia this summer. Rig will leave the Gulf Coast this month.

Exploration people will chuckle at this: A core-drilling crew has made the first spectacular discovery in Libya for Socony Mobil. The crew was drilling structure holes on a big tract in the Libyan desert in Eastern Fezzan. At 1,510 ft. the bit broke into a high-pressure gas zone. Flow was estimated at 2,000 M.c.f. of gas daily. It took 127 sacks of cement to kill the flow.

DRILLING: Arrow Drilling Co. is going abroad. It has teamed with Keir & Cawder of England and Scotland to launch drilling operations in the Middle and Far East, Europe, and Africa. Arrow personnel will direct the drilling operations.

Reading & Bates Offshore Drilling is expanding. Company has just ordered a $2.5 million mobile, tripod drilling platform for drilling work in the gulf.

Kerr-McGee has bought the first in-stock drilling platform offered by Continental-Emsco. The equipment will be put to work this summer in Venezuela's Lake Maracaibo on a block recently acquired by a group headed by Sun Oil.

Largest mobile drilling platform ever built will be commissioned at Beaumont late this week. It's Mr. Gus II designed for drilling in water up to 150 ft. deep. It is an enlarged and modified version of the original Mr. Gus which recently capsized.

Shell Development has tested successfully a new acoustic logging tool to a depth of 18,855 ft. The new tool is a small-diameter version of Shell's dual-receiver continuous velocity logger which has been used experimentally in the U.S. and Canada for several years. The newer tool may extend application of velocity logging to very deep and small-diameter holes.

PRODUCTION: Crude stocks are piling up in Texas. And the buildup will continue through June. Producers fear this means heavy pipeline proration next month. The lines already are prorating in some traditionally soft-market producing areas. The Texas Railroad Commission, however, ignored crude buyers' pleas for a severe cutback in June allowables. It cut production only 77,441 bbl. daily, the smallest reduction possible. Louisiana also cut its June allowable 50,000 bbl. daily.

Some interesting predictions have come from a recent study of the West Coast supply and demand picture. Demand for oil and natural gas is climbing steadily on the coast. Production of both is declining. By 1965, the western region will have to bring in 1,000,000 bbl. daily of oil. Imports of gas from other states will jump 161 per cent.

PIPELINING: Longest pipeline movement of butane ever reported may result

from a deal being negotiated by Phillips and Standard of Ohio. Standard plans to buy 400,000 bbl. of butane from Phillips for use in blending at its Lima, Ohio, refinery. Standard will move the product 1,000 miles from the Texas Panhandle to Ohio in weekly 20,000-bbl. batches between October 1 and March 1. Three different pipelines will be used.

Here's one explanation why Trans-Canada crews are off to a flying start this season: Pipe was double-jointed into 80-ft. sections and strung along the frozen, snow-covered right-of-way during the winter. One contractor started ditching while frost still was on the ground.

A new crude pipeline out of the Williston basin is feasible, according to preliminary studies of the line proposed by Great Northern Railway. A throughput of 25,000 to 30,000 bbl. daily is possible. Tentative planning calls for a 12 to 20-in. line, 400-600 miles long, from Montana to Minnesota. Final decision on building the line will await completion of all the studies.

Course of Argentina's proposed $350-million oil-industry expansion program is uncertain. Deadline for acting on bids from American and European companies for three pipeline projects and refineries passed without any decision. The construction-financing package offered by foreign contractors and suppliers was designed to cut the $200-million annual exchange drain for oil and coal imports.

REFINING: Texaco's 8,000-bbl. refinery at Sunburst, Mont. is scheduled to be shut down next year or early in 1959. Action will come when Texaco opens its 40,000-bbl. Puget Sound refinery at Anacortes, Wash. This plant will allow Texaco to shift its products-distribution and supply system as well.

Tidewater's ultramodern new 130,000-bbl. refinery south of Wilmington, Del., was dedicated last week in ceremonies attended by leaders of business, industry, and government. For details on the new plant see page 159.

While the public got its first peek into Texas Butadiene & Chemical's new $3-million plant at Houston last week, one new fact emerged about the plant: It may be the world's largest single purchaser of L.P.G. The butadiene plant will need nearly 600,000 gal. of ordinary butane daily, 180,000 gal. of isobutane, and 65,000 gal. of isopentane. It's also the nation's first privately financed butadiene plant.

Gasoline taxes have gone up in four states and been dropped in two. Indiana and Utah have put on 2-cent increases. South Dakota and Oklahoma have posted 1-cent boosts. The Oklahoma levy was a special 7-month tax to raise funds for repairing flood-damaged roads and bridges. Montana and Pennsylvania made 1-cent cuts. Additional taxes have been proposed in 12 states, but no action has been taken yet.

South Korea is trying to interest American oil firms in building a new refinery in that country. Invited to discuss the project are Gulf, Standard-Vacuum, and California Texas Oil.

Austria soon may return to private ownership two refineries under state control since the Nazi invasions. Owners were Socony Mobil and Royal Dutch-Shell.

Boilers will be fired early in June on a 14,500-bbl. refinery at Hattiesburg Miss. Pontiac Eastern will put its cat cracker to work in July, the full plant on stream in September.

News about

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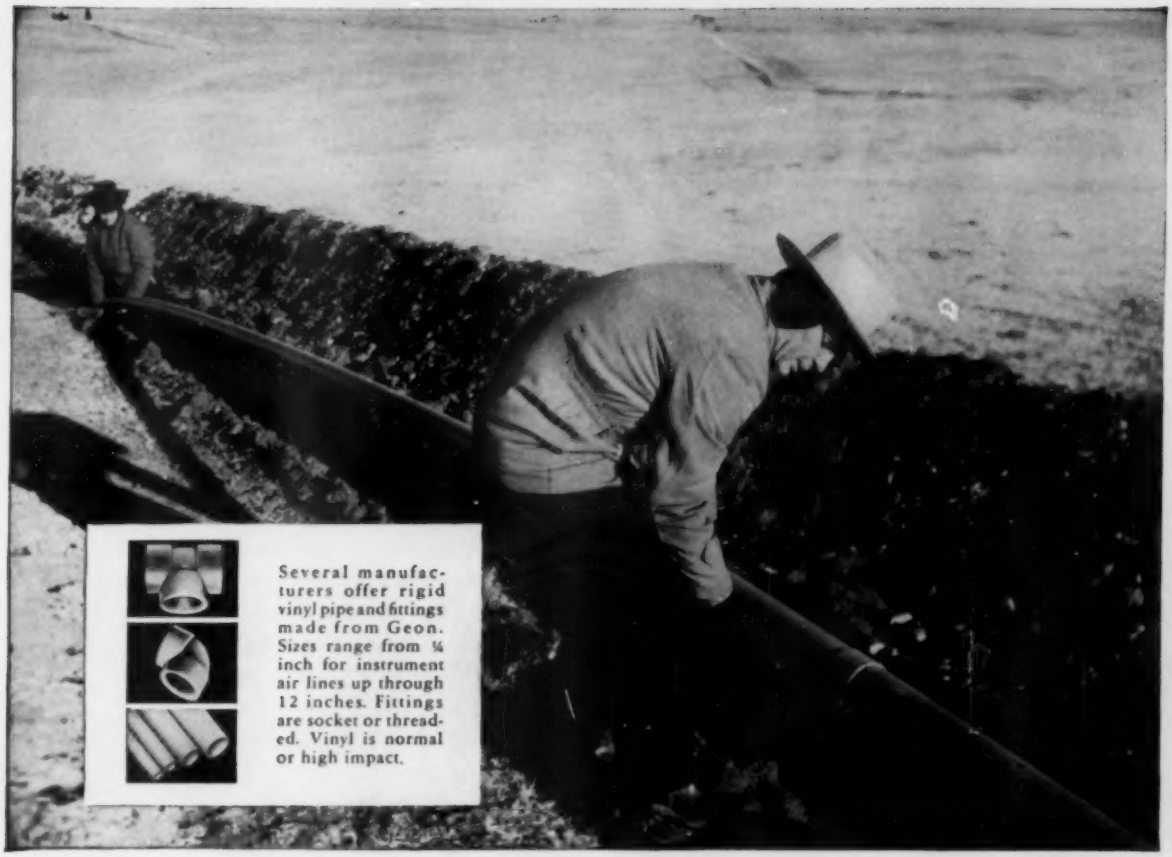

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IN THE NEWS

General Interest:

Crude-Oil Imports Head for New High 85
Eisenhower Sidesteps Fight Over Depletion Allowance 86
Atlantic Gives Foreign Recruiting a New Look 87
West Coast Faces a Fast-Growing Shortage 100
Widespread Proration Looms in Texas 104
Fishing Village Set for Conversion to Giant Port 106

Drilling and Exploration:

Mr. Gus II, Offshore's Biggest Barge, Almost Ready 93
Opening of Promising Alaska Area Pushed in Congress 98
Supply Firm Stocks Tenders for Lake Maracaibo 102
Gulf Options Big Offshore Lease to C.A.T.C. 103
Interior Planning New Offshore Lease Sale 105
New Bill Would Open Iran to Private Companies 107
French Report Success at 5-Mile Stepout in Desert 107
Sun Takes Farmout on 750,000 Acres in Colombia 107
How Structures Originate 311
A New Basin Appears—Palo Duro 312

Pipelines:

C.A.T.C. Group Cleared to Sell Gas to T.G.T. 93
Plan to Combine Texas Gas Fields Touches Off Fight 96
Great Northern Railway Studies Williston Outlet 97
Service Pipe Line Buys 1,000-Mile Crude System 99
Pipeline Briefs 101
Sohio to Move L.P.G. 1,000 Miles by Pipeline 103
Big Mid-East Outlet to be Built by Early 1960's 106

Processing:

Sinclair Firms Up Wage Pattern with 6 Per Cent Offer 98
Oklahoma's Gasoline Tax Goes Up in a Hurry 98
Texaco to Close Montana Plant with Anacortes Opening 102
Industry Gets First Look at Texas Butadiene Complex 104
Processing Briefs 105

Natural Gas:

Gas Storage is Big Business and Getting Bigger 88
TIPRO Gives Conditional Support to Gas Bill 94
Gas Bill Firmly Deadlocked in House 95

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SPECIAL TIDEWATER REFINERY SECTION

Foldout Section-Panorama and Simplified Flowsheet . . . 159

This Refinery Didn't Grow . . . 167
By J. P. O'Donnell

Who's Who in Operation . . . 170

Flexibility is Designed Into Crude Unit . . . 171
By W. E. Colburn

The Fluid Coker . . . 173
By J. A. Whitcombe

The Fluid Catalytic Cracker . . . 174
By J. M. Phelps

Gas Plant . . . 176
By J. A. Baird

Polymerization Unit . . . 177
By S. H. Dyer

Alkylation Unit . . . 179

Extraction Section . . . 180
By H. W. Day

Houdriformer Unit . . . 181
By H. W. Day

Desulfurizer Unit . . . 183
By H. W. Day

Hydrogen Plant . . . 184
By J. V. Class

Sulfur Plant . . . 186
By J. M. Phelps

Gasoline, Fuel Blending . . . 187
By R. N. Wimpress

Instrumentation . . . 189
By W. C. Gardner and J. E. Leary

Automation Pacemaker . . . 191

Cooling Water . . . 192
By H. P. Evans and E. E. Elliott

Marine Terminal . . . 195
By D. J. Dobbs and J. M. Phelps

Maintenance Program . . . 196

Tidewater Power Plant . . . 251

SPECIAL PIPELINE SECTION . . . 108-119

High Capacity P. D. Meters . . . 108
By D. C. McKinley

Bulk Plants Receive Stock Automatically . . . 113
By W. D. Lomax and H. W. Wilker

Payouts . . . Booster Stations vs. Looped Lines . . . 116
By N. B. Mavris

TECHNOLOGY—OPERATION

Do Fracture Fluids Damage Productivity? . . . 120
By Dr. H. K. van Poolen

Finding Well-Bore Damage from Drill-Stem Tests . . . 125
By Albin J. Zak, Jr., and Phil Griffin III

How Corrosion Attacks Well Casing . . . 136
By Y. W. Titterington

How They're Reducing San Juan Fracturing Costs . . . 146
By Ewell N. Walsh

Refinery Construction Report . . . 132

On The Job . . . In The Fields . . . 141

Field Processing . . . 142

The Foreman's Page . . . 153

Questions on Technology . . . 155

Refiner's Notebook . . . 157

PETROdatics . . . 158

Pipeline Patrol—Construction Report . . . 263

DEPARTMENTS

They Say	65	Questions on Technology	155	Personals	325
Calendar of Events	72	Refiner's Notebook	157	Deaths	327
Journally Speaking	79	PETROdatics	158	Statistical Summary	328
Editorial	81	Pipeline Patrol	263	Drilling Statistics	329
Watching Washington	99	Drilling Contractors	286	Supply Statistics	330
International News	106	New Equipment	290	Refining Statistics	331
Refinery Construction	132	Trade Literature	299	Markets	332
On the Job . . . In the Fields	141	Equipment Men in News	303	Classified Advertising	333
Foreman's Page	153	Exploration Highlights	311	Advertisers' Index	339

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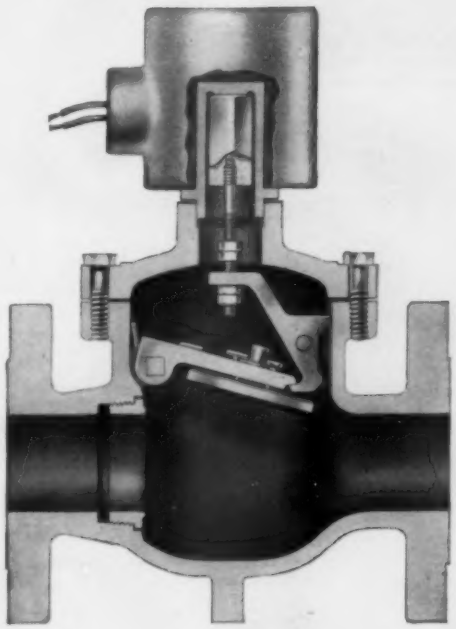
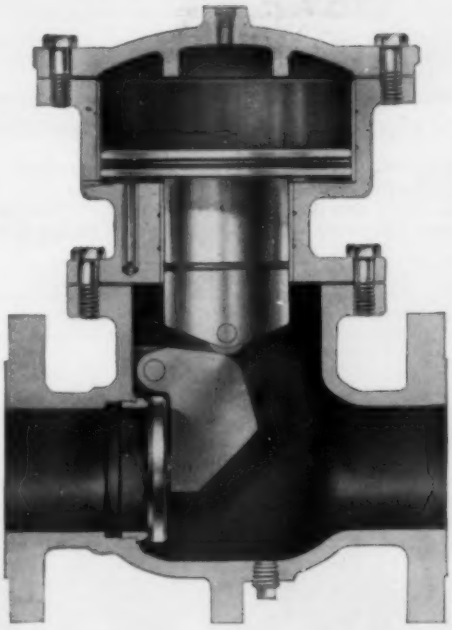


Piston type valve opens instantly



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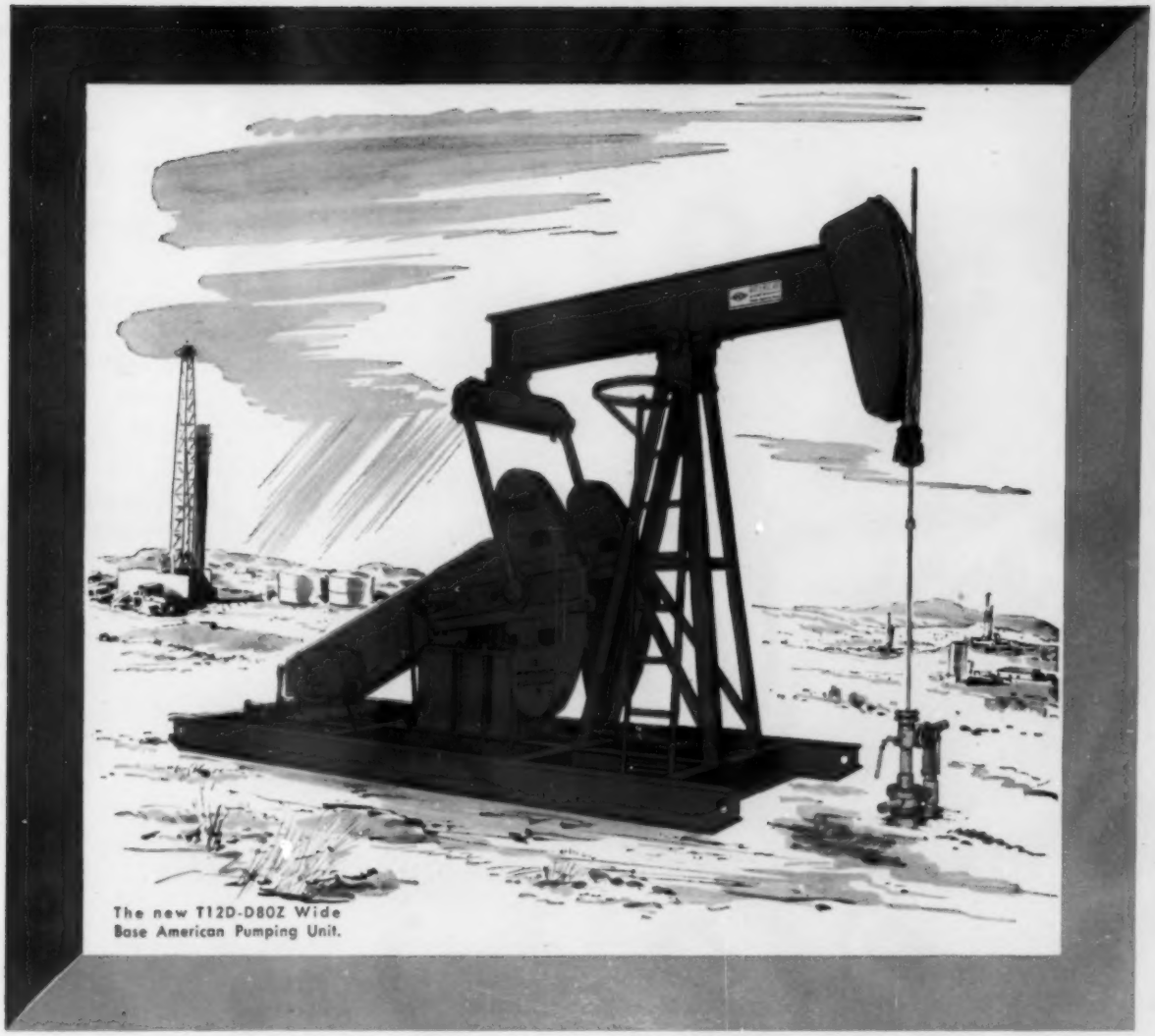

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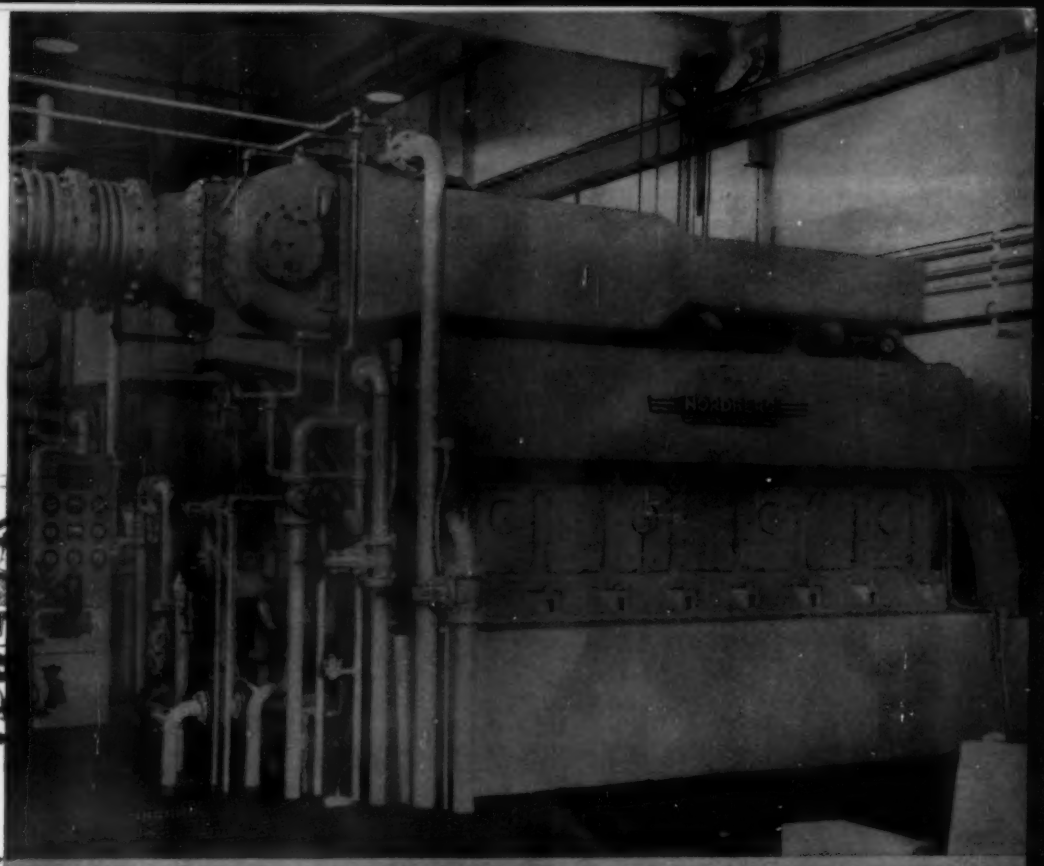
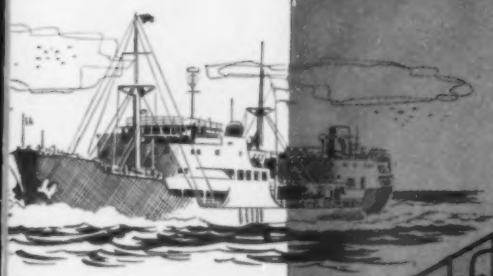


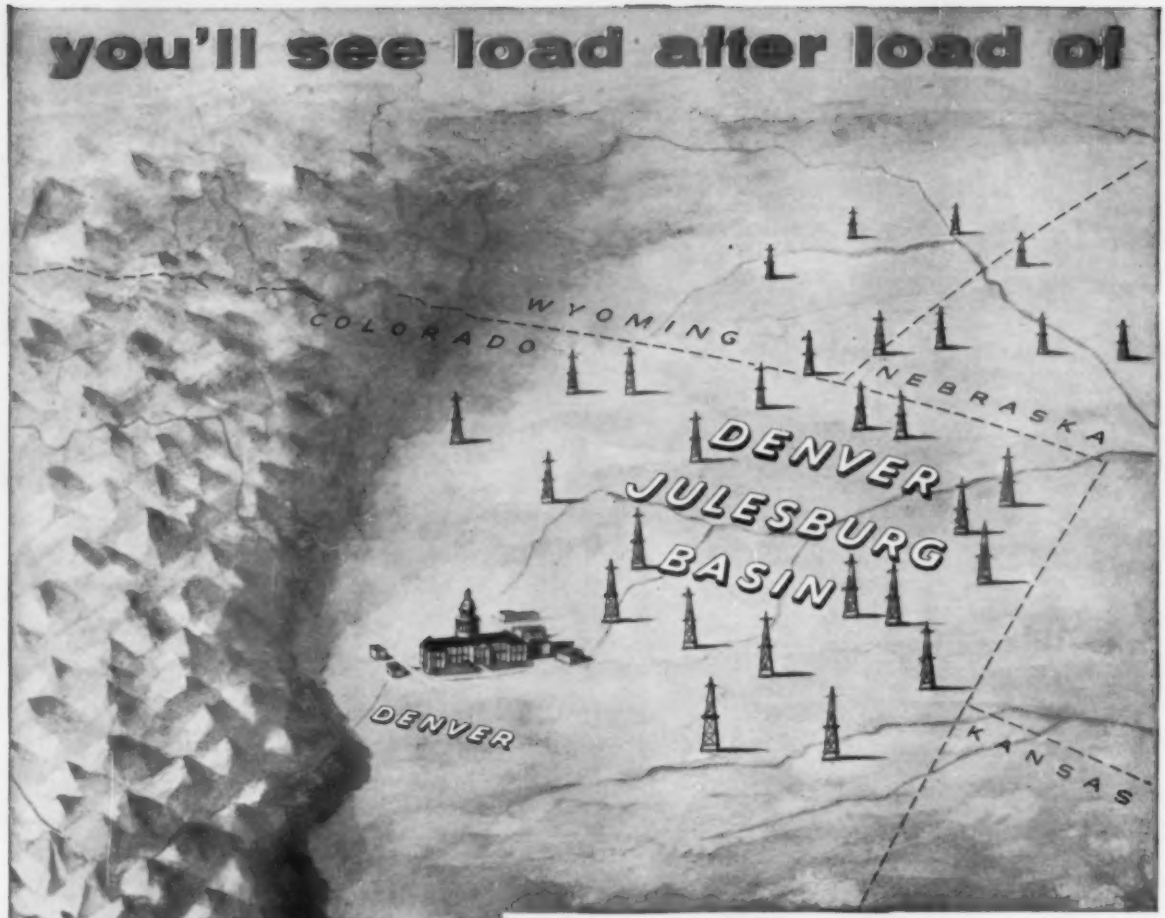
These 2000 hp *Supairthermal*® pipeline engines have been in operation over 20,000 hours with extremely low maintenance. They are part of a total of 24 Nordberg engines to be installed along the Trans Mountain Pipe Line from Edmonton, Alta., to Vancouver, B.C.



M/S ISLAS MALVINAS, large Argentine tanker, is one of three sister ships, each powered with 2 Nordberg 4250 hp 2-cycle Diesel main engines, and 4 Nordberg 465 hp 4-cycle Diesel auxiliary engines, for a total of 10,360 Nordberg Horsepower on board.

Builders of America's Largest Line of Heavy Duty Engines

you'll see load after load of



CF&I SEAMLESS CASING and TUBING

in the Denver-Julesburg Basin

There are good reasons for such acceptance. Every foot of CF&I Seamless Casing and Tubing is made under rigid quality controls to assure dependable service. And CF&I's mill at Pueblo, Colorado, is ideally located to give prompt, efficient service even on emergency rush orders. No wonder so many operators in the Denver-Julesburg Basin, and all over the West, depend upon CF&I Oil Country Goods!

Made to API STD 5A specifications, CF&I Seamless Casing and Tubing is available in popular sizes from 2⅜" through 9⅝" O.D.

3693

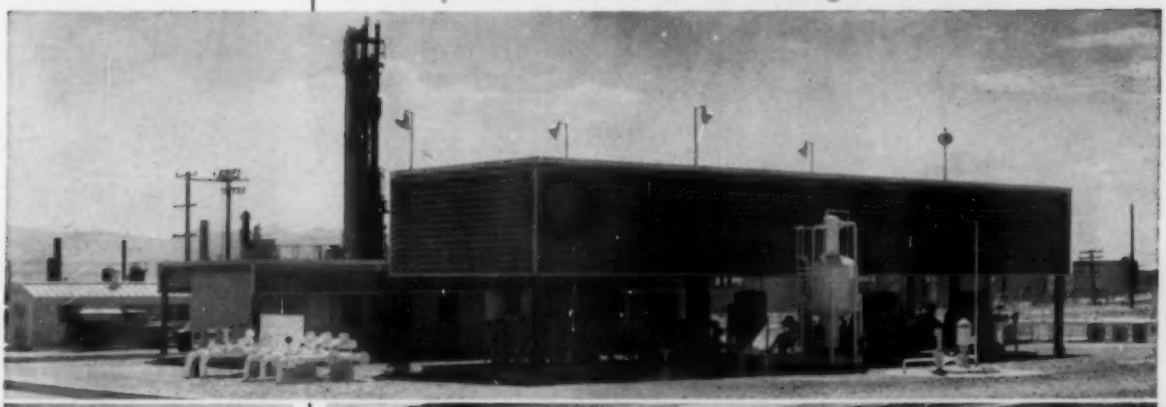
SEAMLESS TUBULAR PRODUCTS
THE COLORADO FUEL AND IRON CORPORATION
Denver, Colorado

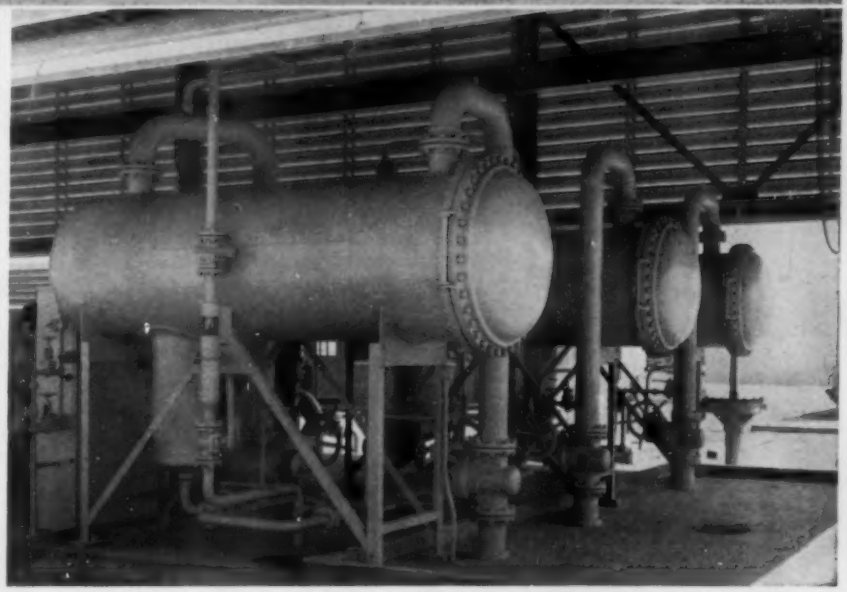
CF&I

SOUTHERN PACIFIC PIPE LINES, INC.

select EXCEL-SO

water separators and meter calibrating tanks*





Warner Lewis Company

BOX 3096 • TULSA, OKLAHOMA

DIVISION OF FRAM CORPORATION

**These two famous EXCEL-SO pipeline products insure maximum product cleanliness and meter accuracy— eliminate costly corrosion and meter repairs*

High volume strainer/separators and large capacity meter calibrating tanks for a complete range of petroleum products—all in high pressure design where required—a specialty with the Warner Lewis Company. Years of experience in design and fabrication of this equipment for pipeline service are available for assistance in planning your installation. Write Warner Lewis Company for further information.

Representatives in all major cities
In Canada, Fram Canada Ltd.
Stratford, Ontario

What you need here is an ALDRICH PUMP

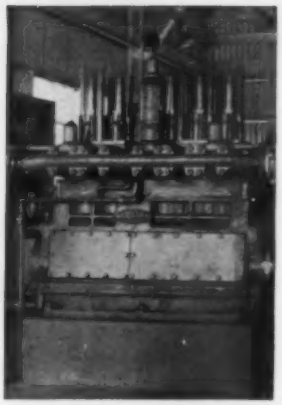
Where pumping operations demand *complete reliability*, Aldrich Pumps assure it—along with unusual freedom from maintenance.

Dependable service. Continuous, heavy duty pumping—at high pressures—is routine with Aldrich Pumps. Aldrich gives dependable low-cost performance in waterflooding, pipe line, gasoline plant, hydrocarbon, injection and petrochemical services. The simplicity of the Aldrich Direct Flow design and the reduced space between valves result in higher volumetric efficiency.

Low-cost maintenance. Fluid end sectionalization, with changeable plunger sizes and interchangeability of parts, means long life and fast, easy maintenance. Parts can be replaced easily and quickly, at low cost. Valves can be removed for inspection or replacement without special tools or equipment. Individual sections of the fluid end can be replaced at a fraction of the cost of conventional type fluid ends.

Get full details. Write for your copy of Data Sheet 100, a condensed catalog and selection table covering our entire line. The Aldrich Pump Company, 9 Gordon Street, Allentown, Pa.

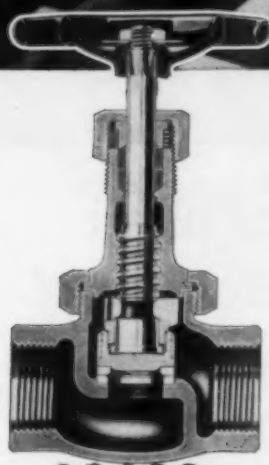
Field parts stock available in Carmi, Ill., Charleston, W. Va., Houston, Los Angeles, Odessa, and Tulsa.



Two Aldrich 3½" x 5" Direct Flow Pumps on lean oil service. Aldrich Direct Flow units are available in 2½", 3", 5" and 6" stroke sizes with 3, 5, 7 or 9 plungers. Sizes range from 25 to 2400 hp.

THE ALDRICH PUMP COMPANY

IT'S TIME TO CUT *Maintenance* COSTS



LQ600

Backed by cost-cutting Distributor service . . . you can't beat the exclusive LQ600 for cost reduction. Its patented Brinalloy® seats and discs outwear even 500-Brinell or 1000-Brinell case-hardened stainless.

At no time in history have industrial valve maintenance costs been so high. Labor costs are skyrocketing. Add in your maintenance department overhead and the production time lost because of valve breakdowns, and your total maintenance cost figure is pretty close to the danger mark. The price of an ordinary valve is actually dwarfed by the cost of keeping it in operation. That's why it always pays to install *the best valves you can buy.* For nearly a hundred years, they've been made by The Lunkenheimer Company, Cincinnati 14, Ohio.

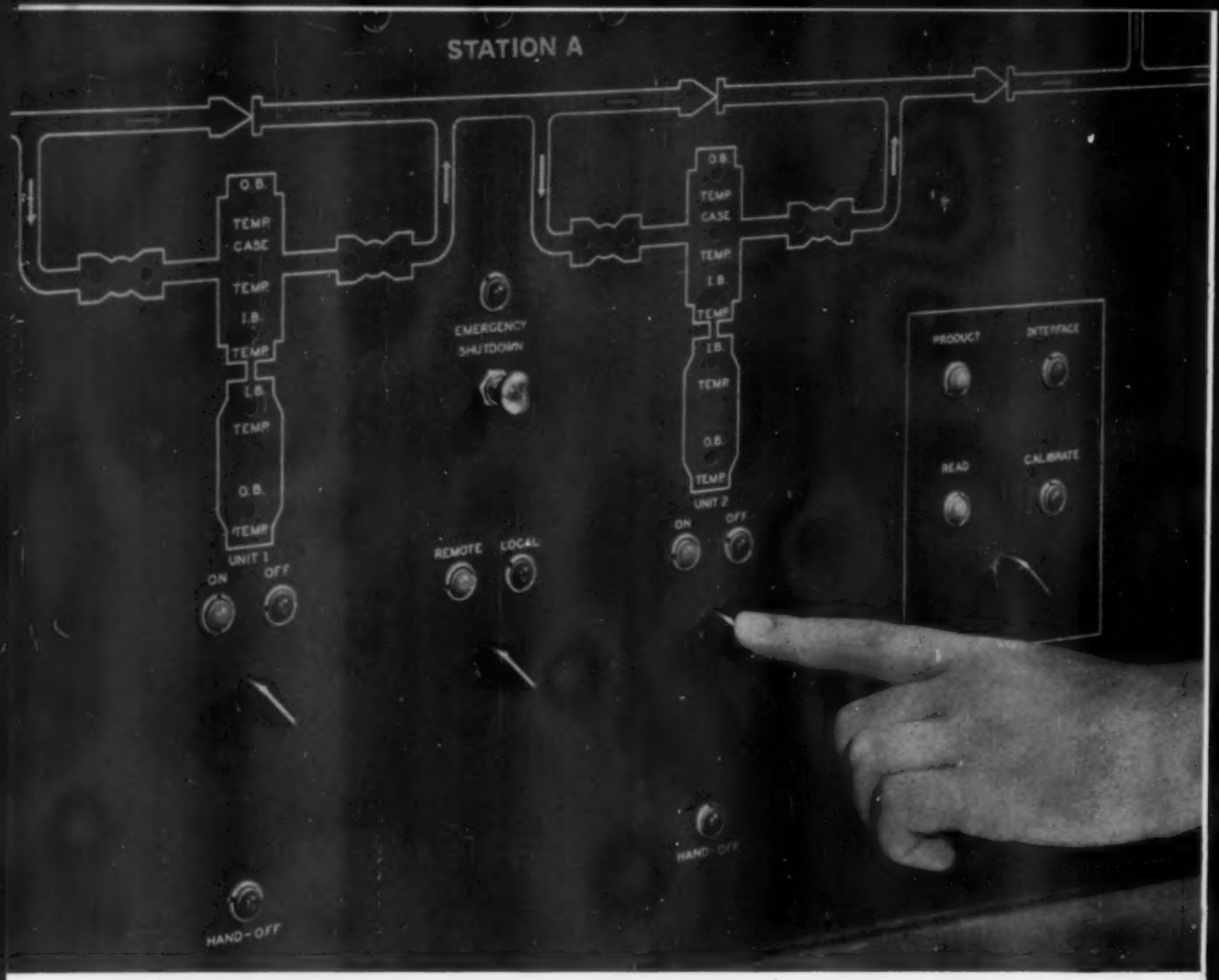
The cost of a LUNKENHEIMER VALVE
Gets smaller . . . and smaller . . . and smaller
with each passing year of dependable service.

BRONZE • IRON • STEEL • PVC

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-557-10



How to push a million gallons of oil from Texas to Chicago—*with one finger!*

A DISPATCHER, sitting at a control console in a central dispatching office, pushes a button—and Centralized Transport Control by Union Switch & Signal does the rest. Hundreds of miles away, a remotely controlled pump hums into action, giving the flowing oil the boost it needs. This is but one of many pumps, located in stations along the entire length of the pipeline, which are all controlled from the console.

On the control console, lighted diagrams tell the dispatcher exactly what is taking place at each pumping station along the line—which pumps are on the line, which valves are open. He can also obtain the temperature and pressures of the moving oil.

The dispatcher receives up-to-the-minute information constantly and automatically. He knows at all times what is happening throughout the entire system. He has fingertip control of all the pumps and valves that enable him to deliver oil at its destination in the most efficient and economical manner.

In the field of push-button science, Union Switch & Signal's record of achievement has been outstanding. In addition to control and communications equipment for pipelines, railways, subways, steel mills, and the mining industry, we have also designed and constructed electronic flight simulators, missile launchers, and air traffic control equipment.

We would welcome the opportunity to put our engineering knowledge and complete manufacturing facilities to work for you.

GENERAL APPARATUS SALES

UNION SWITCH & SIGNAL

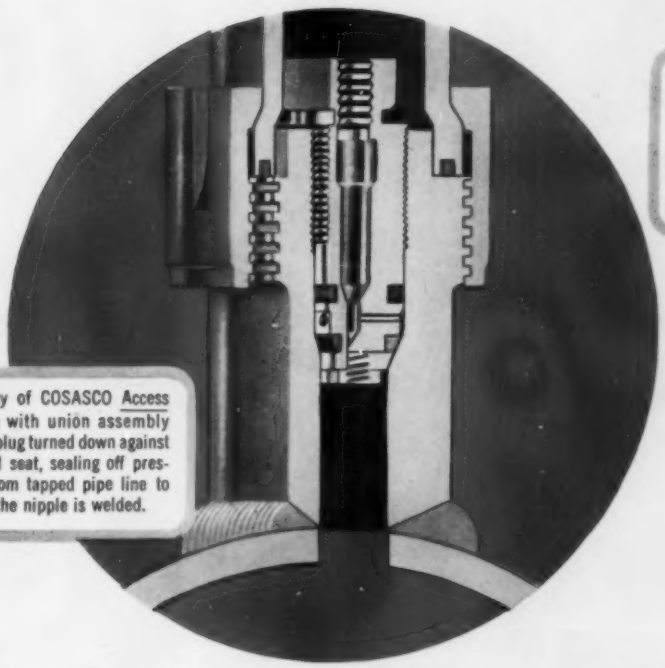
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

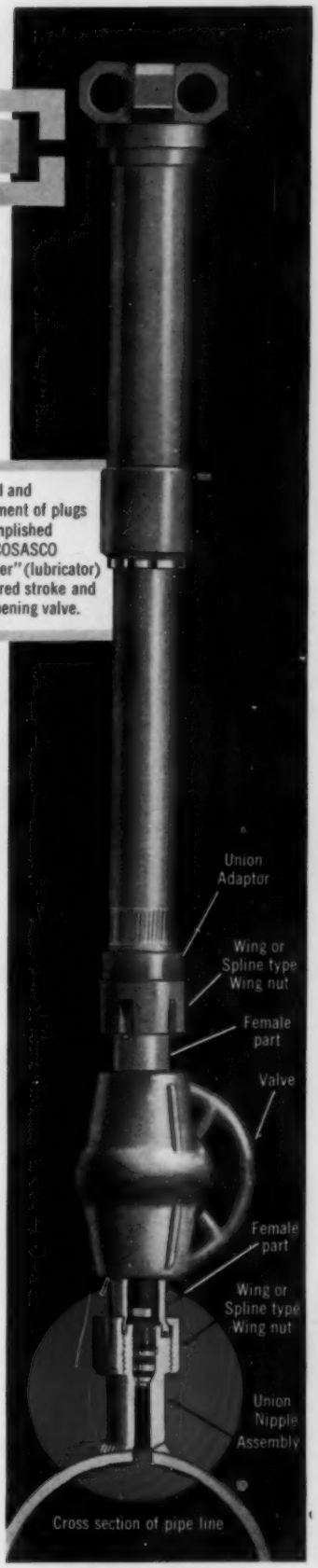
SAFE

entry against pressure

...to insert instruments, replace valves, investigate corrosion!



Cutaway of COSASCO Access Nipple with union assembly shows plug turned down against tapered seat, sealing off pressure from tapped pipe line to which the nipple is welded.



Removal and replacement of plugs is accomplished with a COSASCO "Retriever" (lubricator) of required stroke and a full-opening valve.

COSASCO *Access* Nipples give you safe and easy entry into well heads, refinery vessels, storage and transmission equipment *without interfering with operations*. They also replace expensive valves and permit removal of other externals *without loss of pressure or product!*

The COSASCO *Access* Nipple has a removable threaded plug of type 303-304 stainless steel which seals off the nipple when turned down against the tapered seat. This plug is readily replaced by special plugs for inserting corrosion coupons, water samplers, thermocouples, hydrogen probes, etc. The *Access* Nipple can also function as a gauge valve or bleeder valve.

What's your problem?

If you have an entry-against-pressure problem, we invite you to submit details. Send blue prints or drawings depicting the problem and we'll supply the COSASCO solution *without charge*. You will be under no obligation whatsoever for this service.

Protect equipment... save product

COSASCO DIVISION OF PERFECT CIRCLE CORPORATION

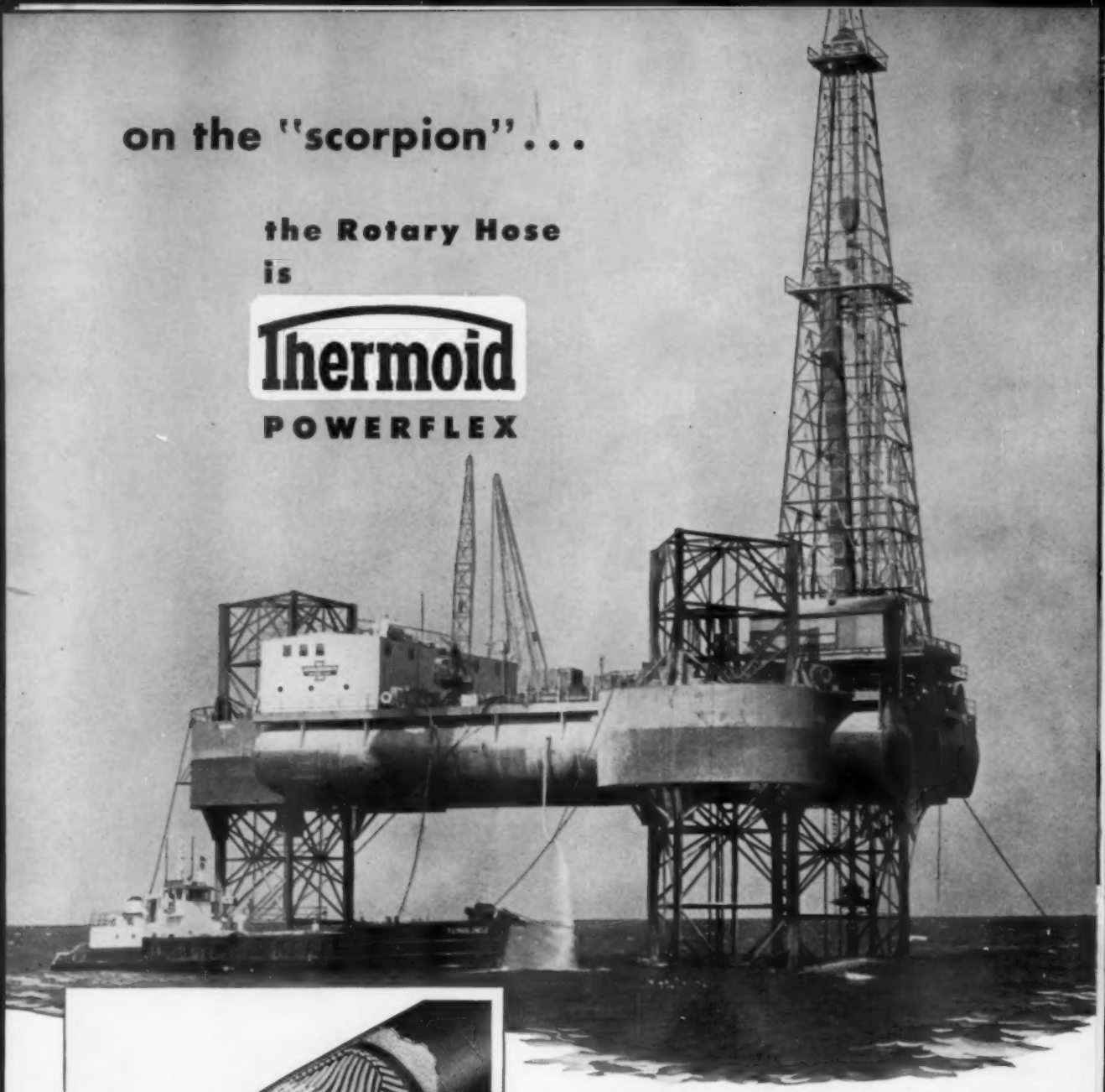
3463 Ocean View Boulevard, Glendale 8, California
Address Mail to P. O. Box 277, LaCanada, California
Export Office: 617 S. Olive Street, Los Angeles 14, California

on the "scorpion"...

the Rotary Hose is

Thermoid

POWERFLEX



The patented full flow coupling at the left is just one reason why the Scorpion is equipped with Thermoid Powerflex Rotary Hose. It's an integral part of the cable assembly—cannot leak or pull off. The cable itself is made up of *33 miles of high tensile steel-wire* wrapped and counter wrapped. And the tube and cover of Powerflex Hose are made with oil and abrasion resistant Neoprene, reinforced with impregnated multi-ply woven fabric.

You'll also find Thermoid Suction and Discharge Hose and Thermoid Multi-V Belts "aboard" the Scorpion for the same reason—superior quality construction. Order Thermoid Oil Field Products from your nearest supply store or Thermoid warehouse.

Thermoid

THERMOID COMPANY, TRENTON, NEW JERSEY, NEPHI, UTAH
Warehouses: HOUSTON, OKLAHOMA CITY, ST. LOUIS, CASPER, LOS ANGELES

TRECO—CONTRACTOR TO AMERICA'S FAMOUS REFINERS*

The REFINERY ENGINEERING Company is proud to have served the majority of America's best-known refiners in the field of Engineering, Design and Construction. Each year sees our list of satisfied clients expanding.

Back of this steady expansion is the satisfactory completion of each contract on, or ahead of time; the ease and economy of operation of the plant as well as the small amount of "down time."

Treco has purchased a tract of land, in excess of three acres. This new facility provides more than 14,000 square feet of air-conditioned offices with paved parking for over 200 cars. There is also a cafeteria building and two other buildings of 9,700 feet and 37,000 feet of space for expanding Treco activities.

* The Trade Marks above are of the companies Treco has recently served.

The REFINERY ENGINEERING Company has just produced a brochure which shows the Company's facilities with photographs of completed projects. A copy will be mailed you promptly upon request on your company's letterhead.

ESSO STANDARD OIL COMPANY

McCOLL-FRONTENAC OIL COMPANY, LTD.

PHILLIPS PETROLEUM COMPANY

CONTINENTAL OIL COMPANY

SHELL OIL COMPANY

THE TEXAS COMPANY

SINCLAIR REFINING COMPANY

COSDEN PETROLEUM CORPORATION

D-X SUNRAY OIL COMPANY

ROYALITE OIL COMPANY, LTD.

KERR-McGEE OIL INDUSTRIES, INC.

TRECO

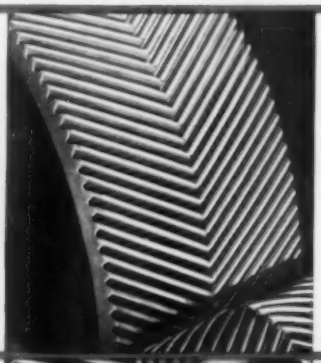
DIVISION of VITRO CORPORATION of AMERICA

The REFINERY ENGINEERING Company

NEW YORK TULSA TORONTO

In the market for speed increasers? then compare these Farrel® features...

1 GEAR WITH A BACKBONE



Instead of a center groove, the gears in a Farrel speed increaser have a *backbone*, formed where the helices meet. This *backbone* puts the full face width of each gear to work transmitting power. Result: Extra strength and greater load-carrying capacity in smaller space.

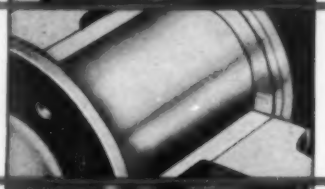
2 "FOUNTAIN OF YOUTH"

Self-contained circulating oil system puts power on "velvet" by providing a protective spray of oil at the mesh line of the gears and pressure-lubricating the bearings.

3 PRECISION-GROUND SHAFTS

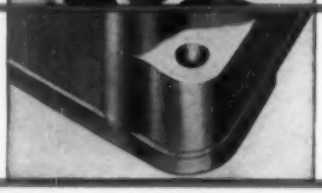
Extra large for the power to be transmitted. Give added stiffness against bending and torsional deflections under peak load conditions.

4 OVERSIZE SLEEVE BEARINGS



With consequent low unit pressures. Precision-finished to extremely close tolerances.

5 VERY RIGID HOUSING



Holds rotating elements in original alignment, insuring continuous operating smoothness of the gears.

These are the features which account for the amazing record of Farrel speed increasers. Since 1932, when the first of these units was put into service, not a single one has ever been replaced.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
Sales Offices: Ansonia, Buffalo, Boston, Akron, Ann Arbor (Mich.), Chicago, Minneapolis, Fayetteville (N.C.), Los Angeles, Salt Lake City

OIL FIELD REPRESENTATIVES:

Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
V. W. Osborne, 860A M & M Building, Houston 2, Texas

Farrel-Birmingham®

FB-1048

Another Goodyear First:

V-Belts *with the* Green Seal

stay matched from factory to drive

The Green Seal signifies true dimensional stability. It means that now when you reach for a matched set of V-belts, you can be sure they're matched – no matter how long they've lain on the shelf. And that means longer life and a minimum of down time.

It used to be that only steel-cable V-belts by Goodyear were length stabilized. But now, through the miracle of Triple-Tempering, they've been joined by all the other Goodyear Industrial V-belts.

Triple-Tempering is the exclusive process wherein synthetic cord is carefully brought to the peak of strength and stability by controlled tempering with Tension, Temperature and Time. And this gives you not only *length* stability in storage, but greater shock- and stretch-resistance on the drive.

In addition to 3-T load-carrying members, the Green Seal also brings you "balanced construction." This means each component of the belt is specifically designed to its job to give you cleaner, smoother, longer running which adds up to maximum, trouble-free horsepower hours at minimum cost.

The next time you need V-belts, be sure they're wearing the Green Seal–the mark of a V-belt made with the technical know-how of the world's largest rubber company. They're readily available at your Goodyear Distributor. Or write for details to Goodyear, Industrial Products Division, Lincoln 2, Nebraska, or Akron 16, Ohio.

DIMENSIONALLY STABLE V-BELTS by

GOODYEAR

THE GREATEST NAME IN RUBBER

Green Seal—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

Announcing...

JOHNSTON

Hydraulic

PUMPING UNITS

"THE MOST ECONOMICAL PUMPING UNIT EVER BUILT"

12-FT. STROKE

CYLINDER MODEL 4512

15,000 LB.

POLISH ROD LOAD

Yes—Here is the Hydraulic Pumping Unit the Industry has long needed—simple, sturdy, trouble-free and priced substantially lower than any other type pumping equipment, mechanical or hydraulic.

THEY ARE PROVEN

From grass roots to 9000 feet—that's the range of Johnston Hydraulic Pumping Units. More than 100 of these units are now in service (Gulf Coast, South Texas, West Texas), and have been operating for a sufficient length of time to prove their merit.

THEY ARE BETTER

The low price of Johnston Hydraulic Pumping Units is due to streamlined, simplified design and manufacture, made possible by years of experience in production and hydraulics.

Remember this: Here is a pumping unit that will SAVE YOU MONEY —Cost You Less than any competitive unit; Less for Transportation; Less for Installation; Less for Maintenance; Increase Life of Sucker Rods, Bottom Hole Pump, and in many instances increase production.

THEY COST LESS

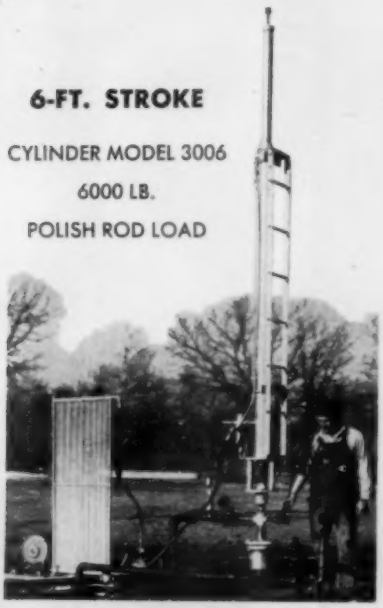
DISTRIBUTED THROUGH SELECTED SUPPLY STORES

6-FT. STROKE

CYLINDER MODEL 3006

6000 LB.

POLISH ROD LOAD

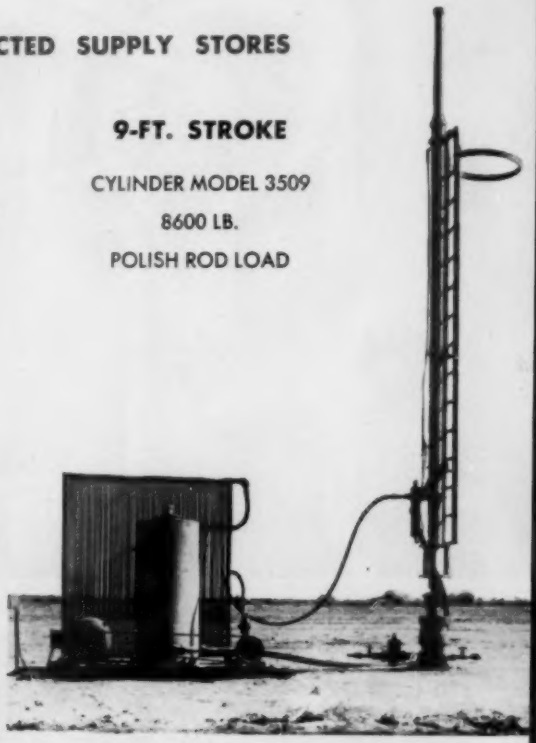


9-FT. STROKE

CYLINDER MODEL 3509

8600 LB.

POLISH ROD LOAD



THE "PEE WEE"
(3-FT. STROKE)
CYLINDER MODEL 2503
4000 LB.
POLISH ROD LOAD

MAIL THIS COUPON FOR SPECIAL PAMPHLET CONTAINING APPLICATION CHART AND MECHANICAL FEATURES OF JOHNSTON HYDRAULIC PUMPS . . . NO OBLIGATION.

ENGINEERED OIL TOOLS, INC.
P. O. Box 1665 • Houston, Texas

Please mail special pamphlet on Johnston Hydraulic Pumps to:

Company

Person

City State

DISTRIBUTED THROUGH SELECTED SUPPLY STORES BY

ENGINEERED OIL TOOLS, INC.

1710 BURNETT ST. — HOUSTON, TEXAS

result of an engineer's good common sense

This piping installation is here to stay, thanks to B&W Seamless Welding Fittings

THE engineer who specified B&W Seamless Welding Fittings on this boiler job knew what he was doing. He realized the system would have to be permanent and leakproof for many years to come. He also realized how much time and money could be saved in fabrication, and, of course, insulation. Therefore, it was only natural that he chose welded connections since they actually become part of the piping system and are as strong, or stronger than the pipe itself. Pipes nest closer and the overall system is considerably lighter.

B&W Seamless Welding Fittings are dimensionally accurate. Full radius, true circularity and smooth walls of uniform thickness provide a smooth, fast-moving flow even under highest temperatures and pressures.

This time, specify B&W Seamless Welding Fittings and Forged Steel Flanges for a permanent and leakproof piping system. They're available in a complete range of sizes and types in alloy (B&W CROLOYS) carbon and stainless steels.

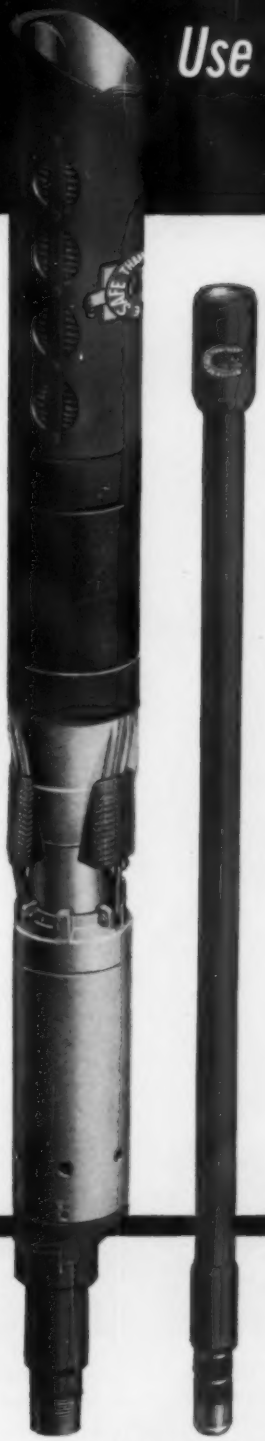
FA-7907-FE3

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION — FITTINGS DEPARTMENT
3839 WEST BURNHAM STREET — MILWAUKEE 46, WISCONSIN

SEAMLESS WELDING FITTINGS AND FORGED STEEL FLANGES, SEAMLESS AND WELDED TUBULAR PRODUCTS — IN CARBON, ALLOY AND STAINLESS STEELS

For Dual String Completions – Flowing or Pumping

Use GUIBERSON'S RETRIEVABLE TYPE RD PACKER



Type RD Packer with Anchor and Plain Stinger

This cleanly designed, rugged packer is an outstanding Guiberson development for dual string installations in wells of any depth.

Outstanding in performance because it operates perfectly with both zones flowing, high or low differential pressure; with either zone flowing, the other zone pumping; with both zones pumping; with either or both zones on gas lift; or for multi-zone injection — gas or water.

Outstanding in advantages because it completely isolates each zone from the other and from the casing; provides full opening long string to lower zone; permits either string to be pulled or run separately.

Guiberson's RD packer does complex dual zone jobs so well that operators tell us it's their best investment for dual string production. Ask your Guiberson representative about installation and auxiliary equipment recommendations.

Guiberson's RD packer has smooth operating dovetail slips of heat-treated alloy steel. Packing rubber is one-piece sleeve type — will not vulcanize in the well, made of Guiberson's special oil and gas resistant compound. You can get the RD packer with or without anchor, and a choice of stingers, plain or with jay-hook. Piston slips have extra large gripping area, are heat-treated alloy steel and keyed to anchor body to maintain proper alignment. Get the Best — Get Guiberson.

SAFE THAN SORRY · GUIBERSON · BETTER BE

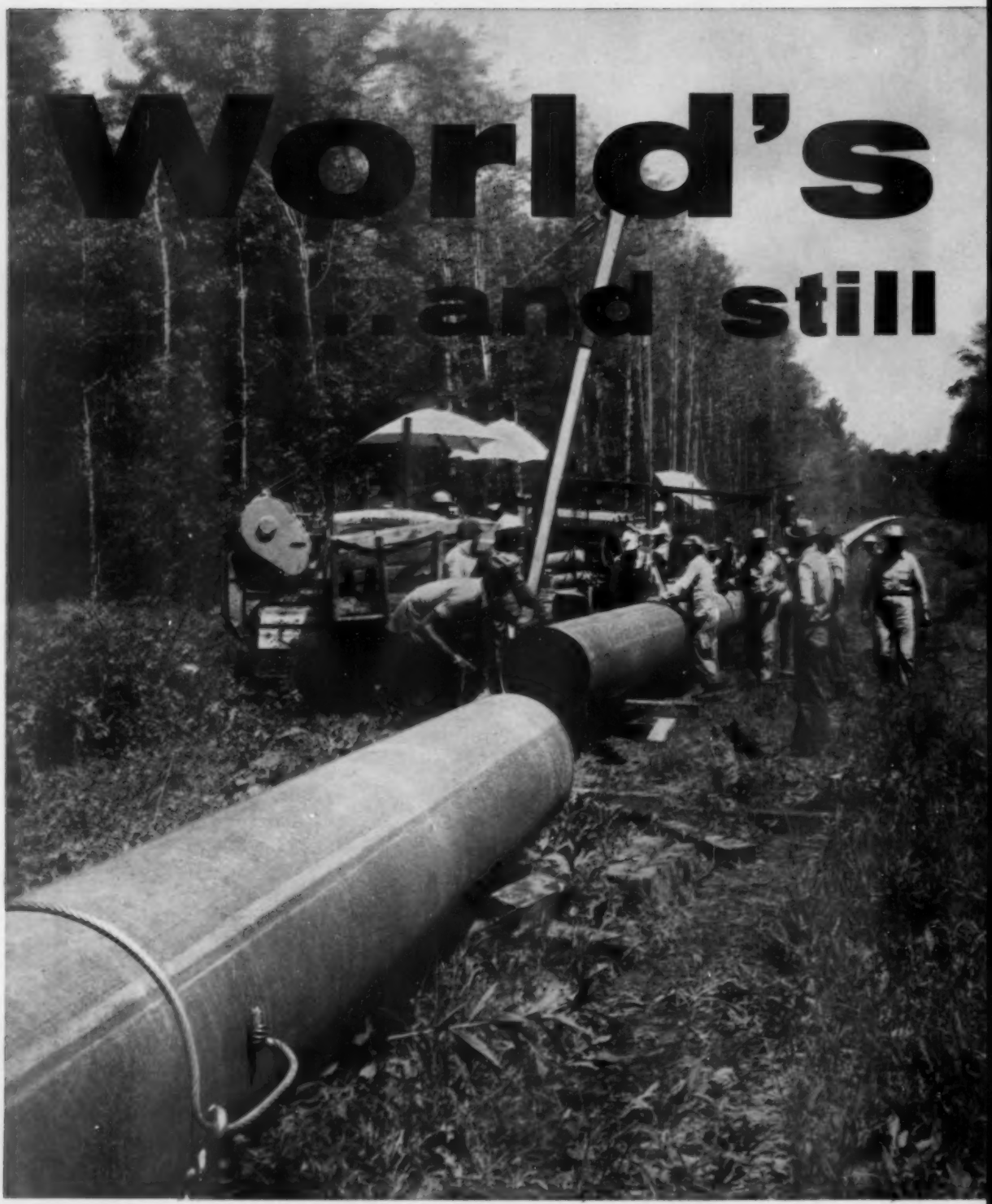
THE

GUIBERSON

CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

Sold by
Oil Field Supply Stores
Everywhere



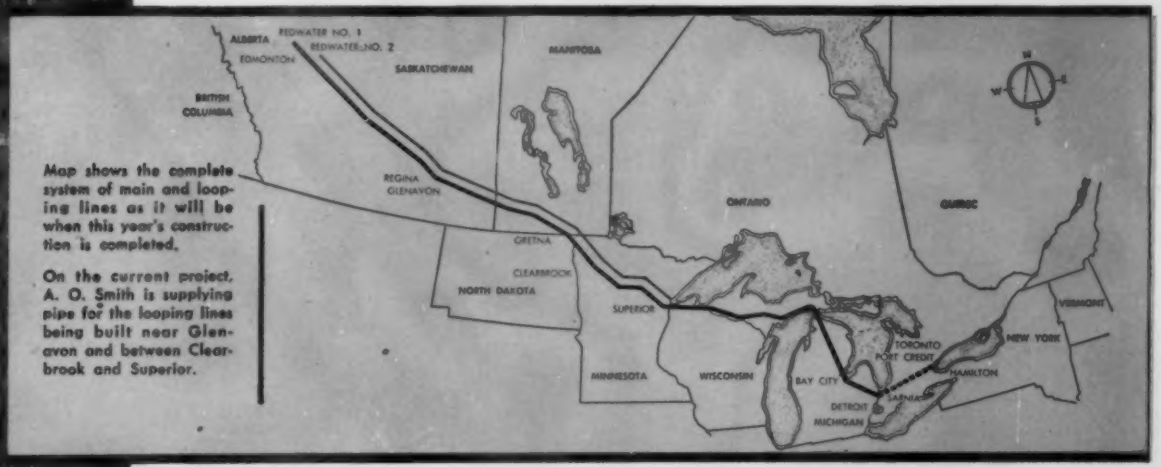
Interprovincial has extended their system from Superior to Sarnia and now from Sarnia to Port Credit, Ontario by the end of this year. It will then include over 3,000 miles of main line and loops. A. O. Smith's contribution to the system will be just above 50% of the total line laid.

longest growing!

Interprovincial Pipe Line Company has 1,774 miles of main line now in service . . . will extend this system another 156 miles during '57

THIS is the big crude oil carrier from Edmonton, Alberta, to refineries in the Prairie Provinces and Ontario in Canada . . . Minnesota, Wisconsin and Michigan in the U. S. Spanning 1,774 miles, it's already the world's longest line of this type and construction is now under way that will increase main line length to over 1,900 miles.

A. O. Smith is proud to have been a part of this great system since the original main line of 1129 miles was constructed in 1950. Over 70% of this original line to Superior, Wisconsin was supplied by A. O. Smith. Since that time from both Milwaukee and Houston mills, A. O. Smith has supplied most of the pipe for the looping work done on this original section in 1953, 1954, 1956 and 1957.



Map shows the complete system of main and looping lines as it will be when this year's construction is completed.

On the current project, A. O. Smith is supplying pipe for the looping lines being built near Glenavon and between Clearbrook and Superior.

For almost 30 years...

A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely-controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is in nearly every important high-pressure line.

Through research ... *a better way*

A.O.Smith
CORPORATION

TUBULAR PRODUCTS DIVISION
Milwaukee 1, Wisconsin

Chicago 4 • Dallas 2 • Houston 2 • Los Angeles 17 • Midland 5, Texas • New Orleans 12 • New York 17 • San Francisco 4 • Seattle 1 • Tulsa 3 • Washington 6, D. C.
International Division: Milwaukee 1, Wisconsin

BOUGHT 40 MORE

Since he first switched to GM Detroit Diesel Power

Back in 1947, Calvert Drilling, Incorporated, started operations with three gas-powered rigs. They promptly switched one rig to General Motors Detroit Diesel power, found this quick-acting, 2-cycle Diesel gave them faster round trips, easier moves and more dependable parts and service availability wherever they went. Now the company has standardized on GM Detroit Diesel power in all their 13 rigs as well as trucks and lighting plants.

Does it pay to standardize on GM Detroit Diesel power? It sure does. For it simplifies your servicing and parts requirements. And you get easier, faster moves *plus* faster, lower-cost drilling, too.

You can get GM Detroit Diesel power (single engines, 30 to 300 h.p.; multiple units, up to 893 h.p.) in over 1,000 different applications of power machinery and boats of all types. For the list, see your local GM Detroit Diesel distributor or dealer.

GM GENERAL MOTORS DIESEL POWER

DETROIT DIESEL

Engine Division of General Motors, Detroit 28, Michigan
REGIONAL OFFICES: New York, Atlanta, Detroit
Chicago, Dallas, San Francisco
Factory Engineered Parts—
Factory Trained Servicemen Everywhere

Calvert Drilling, Inc., Olney, Ill. GM "6-110" Diesel drives Ideco Hydrair draw works, "Twin 6-71" powers Gardner-Denver mud pump.

ALABAMA—Birmingham, Montgomery
ARMSTRONG EQUIPMENT CO.
Mobile
KENNEDY MARINE ENGINE CO.

ARIZONA—Phoenix
DIESEL SERVICE COMPANY

CALIFORNIA—El Monte, Long Branch, Los Angeles
ANDERSON-O'BRIEN CO.

COLORADO—Denver
THE COLORADO BUILDERS' SUPPLY CO.

FLORIDA—Jacksonville, Miami
DETROIT DIESEL ENGINE DIVISION
General Motors Corporation
(Florida Branch)

ILLINOIS—Mt. Carmel
WESTERN SERVICES, INC.

INDIANA—Evansville, Indianapolis
REID-HOLCOMB CO., INC.

IOWA—Sioux City
FEHRS TRACTOR & EQUIPMENT CO.

KANSAS—Great Bend, Wichita
DIESEL EQUIPMENT CO., INC.

KENTUCKY—Lexington, Louisville, Madisonville
BOGIE EQUIPMENT CO.

LOUISIANA—Harvey
GEORGE ENGINE CO., INC.
Shreveport
UNITED ENGINES, INC.

MICHIGAN—Detroit, Grand Rapids
PENINSULAR DIESEL, INC.

MISSISSIPPI—Biloxi
KENNEDY MARINE ENGINE CO.

MISSOURI—North Kansas City
K. C. DIESEL POWER CO.

St. Louis
WESTERN MACHINERY & ENGINE CO.

NEBRASKA—North Platte, Omaha
FEHRS TRACTOR & EQUIPMENT CO.

NEW MEXICO—Albuquerque
HARRY CORNELIUS CO.

NORTH DAKOTA—Williston
GENERAL DIESEL AND EQUIPMENT CO.

OHIO—Cleveland, Toledo, Youngstown
GREAT LAKES DIESEL CO.
Columbus
COLUMBUS EQUIPMENT CO.
Dayton, Cincinnati
FLACK EQUIPMENT CO.
Steubenville
RAY C. CALL, INC.

OKLAHOMA—Oklahoma City, Tulsa
DIESEL POWER CO.

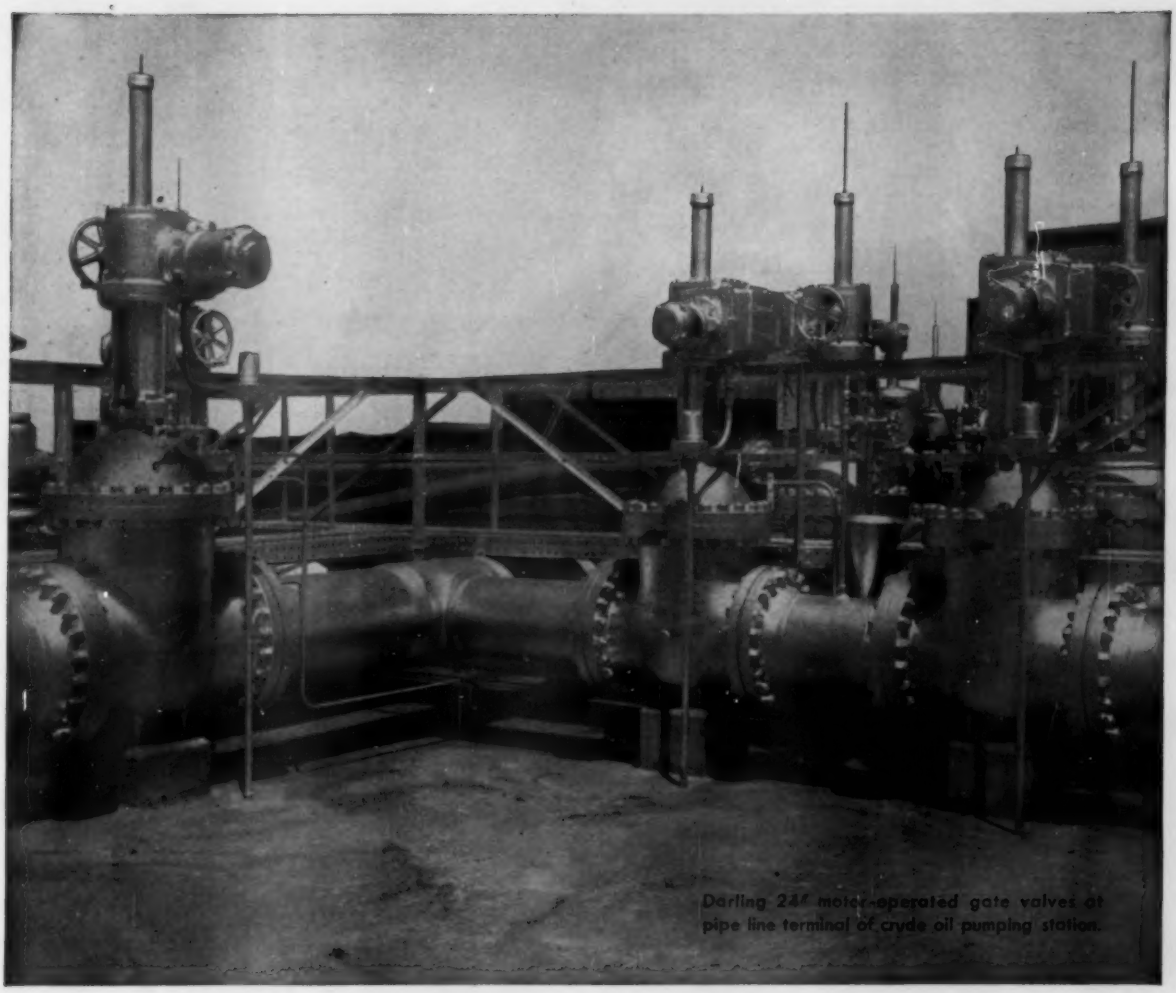
PENNSYLVANIA—Pittsburgh
HIGHWAY EQUIPMENT CO.

TEXAS—Beaumont, Corpus Christi, Dallas, Houston, Lubbock, Odessa, San Juan
STEWART & STEVENSON SERVICES, INC.
El Paso
EQUIPMENT SUPPLY CO., INC.

UTAH—Moab, Salt Lake City
CATE EQUIPMENT CO., INC.

WEST VIRGINIA—So. Charleston, So. Fairmont
RAY C. CALL, INC.

IN CANADA—Distributors in all key locations under
GENERAL MOTORS DIESEL LIMITED
London, Ontario



Darling 24" motor-operated gate valves at pipe line terminal of crude oil pumping station.

Why Darling gate valves work better...longer!

HERE'S the simple answer. There's little that *can* go wrong with Darling *fully revolving double disc, parallel seat gate valves.* This unique principle recognizes and thus *avoids* the common sources of valve failure...

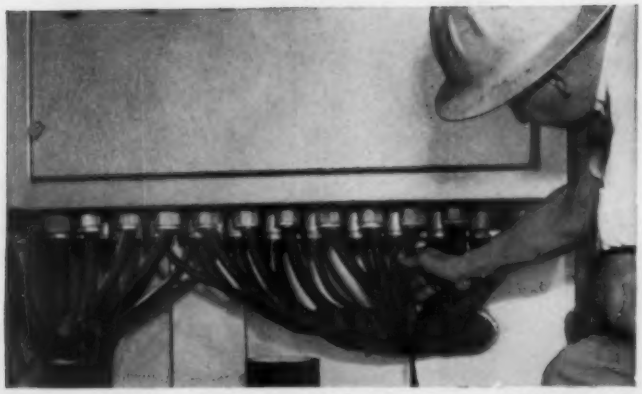
Take seat misalignment for example. The Darling principle automatically compensates for this common cause of leaks! Then too, there's *uniform* distribution of disc-and-seat wear, positive relief of wedging pressure as discs unseat, and *easier operation* even under pressure and temperature extremes.

Finally, with these Darling gate valves that work better, longer, you naturally minimize down time and maintenance expense. Why not get all the facts on Darling gate valves of the proper size and type for your own service needs? We'll be happy to cooperate.

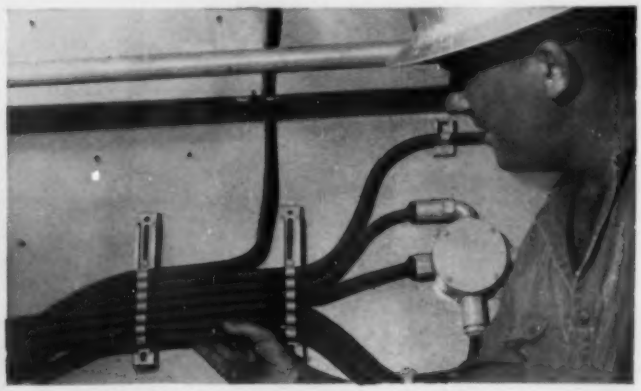
DARLING VALVE & MANUFACTURING CO.

Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



• Exposure to flexing, oil, grease or sunlight won't cause deterioration of neoprene jacketing on this cable. Resistance to flame and aging are two other advantages of neoprene that mean extra safety, extra long service.



• No conduit needed for rugged neoprene-jacketed cable. It resists weathering, ozone, electrolytic attack . . . stays flexible. Cable can be easily repositioned without cracking neoprene jacketing.

ON PHILLIPS PETROLEUM BARGE Nº 41

Neoprene-jacketed cable replaces steel-armored for electrical system

The Phillips Petroleum Company's Drilling Barge No. 41 off Cheraton Beach near New Iberia, La., is equipped with neoprene-jacketed cable. This rugged cable was more economical on a footage basis than steel-armored cable, and offered definite service advantages for the barge's entire electrical system.

Normally the electrical system on a drilling barge is armored with steel to help prevent damage during installation. But engineers found the steel armor served no useful purpose after installation—it was usually allowed to rust away.

McIntosh Electric Co., contractors for No. 41, decided to try cable jacketed with neoprene, Du Pont's synthetic rubber, and their decision was justified. Rugged neoprene jacketing did not crack under severe flexing and abrasion . . . withstood exposure to oil, grease and heat. And flexible neoprene-jacketed cable proved easier to install, easier to splice and naturally eliminated any chance of rust.

Drillers count on neoprene's lasting resistance to weather, sunlight and aging as additional insurance against maintenance and replacement costs. Service records on neoprene parts in oil fields the world over support their conviction. Be sure the cable, drill-pipe protector or rotary hose you buy is made to last . . . be sure that it's made with DU PONT NEOPRENE.

FREE! THE ELASTOMERS NOTEBOOK. Every issue tells interesting stories about neoprene. Actual case histories show how neoprene products cut maintenance and replacement costs . . . improve performance. To get on mailing list, just write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department OG-5, Wilmington 98, Delaware.

NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

5086

HIGHEST STRENGTH ALUMINUM FOR UNFIRED PRESSURE VESSEL FABRICATION

Kaiser Aluminum now offers you alloy 5086 . . . the highest strength aluminum alloy available for the fabrication of unfired pressure vessels.

Non-heat-treatable 5086 is designed specifically for welded structures requiring maximum joint strength and efficiency, plus light weight and corrosion resistance.

And, with high-strength 5086 you can take advantage of inert-gas, shielded-arc welding methods for faster welds and pressure tight joints.

Development of 5086 by Kaiser Aluminum makes possible many new applications of light weight, durable aluminum for the chemical and petroleum industries. Find out now how this versatile alloy can serve you.

For complete information, call the Kaiser Aluminum sales office listed in your phone directory. Process Industries Department, Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

PHYSICAL CHARACTERISTICS OF ALLOY 5086

Typical mechanical properties in various tempers

	Temper			
	"0"	H32	H34	H112
Tensile strength (psi)	38,000	42,000	47,000	39,000
Yield strength (psi)	17,000	30,000	37,000	19,000
Elongation (% in 2")	22	12	10	14

Allowable design stress values

	For metal temperature not exceeding deg. F.	
Condition (temper)	100°	150°
Annealed	8700 psi	8700 psi
H112	8700	8700
H32	10,000	9900
H34	11,000	10,800

Allowable stress values for welded construction compared with other alloys

Alloy Designation		For metal temperature not exceeding 150° F. (annealed condition)
AA	ASTM	
1160	996A	1650 psi
1100	990A	2350
3003	M1A	3150
3004	MG11A	5650
5050	G1A	4000
5052	GR20A	6250
5154	GR40A	7350
5086	GM40A	8700

Nominal composition

4.0% magnesium
0.45% manganese
0.10% chromium

Typical weld strengths (specimens tested across the weld)

37,000 psi tensile strength
18,000 psi yield strength
13% elongation

Kaiser aluminum 5086 is available in flat and coiled sheet, plate and extrusions.

Kaiser Aluminum

materials for the process industries

See "THE KAISER ALUMINUM HOUR." Alternate Tuesdays, NBC Network. Consult your local TV listing.

an ACCO product

American Cable TRU-LAY VHS | 15% STRONGER

For Deeper, Safer, Faster Drilling... New VHS Rotary Drilling Lines

No matter where you go, you'll find that more and more rigs are equipped with rotary drilling lines of new TRU-LAY VHS. Made from a new grade of steel for wire rope, new VHS is at least 15% stronger than IPS—the strongest grade available before VHS.

Drill Faster—Less Down Time

The greater strength of new VHS allows you to drill deeper before increasing the number of parts of line. And VHS's extra strength eliminates, in many cases, any necessity for buying new blocks or regrooving sheaves to use larger diameter lines for higher safety factors.

Higher Safety Factor

The safety factor for 10 lines of VHS is about equal to the factor of safety for 12 lines of IPS. Or the factor of safety for 10 lines of VHS is 14.9 or 15% higher than for 10 lines of IPS.

Resists Abrasion, Peening

New TRU-LAY VHS is tougher, too. Because it is stronger and tougher it has greater resistance to abrasion and higher resistance to peening—both important factors in maintaining shape and diameter. Ton-mile advantages should result if regular adaptable cut-off practices are followed.

Winch-Lines, Too

Winch-Lines of new TRU-LAY VHS are now available with all the advantages this stronger, tougher rope can bring to this grueling application. For Rotary Drilling Lines and Winch Lines of new TRU-LAY VHS . . . get in touch with our office nearest you. You don't need any complicated specifications—just tell us the size and diameter you want.

For further information write to the nearest American Chain & Cable Company office listed at right for
Brochure DH-516H.

ACCO

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AMERICAN CHAIN & CABLE

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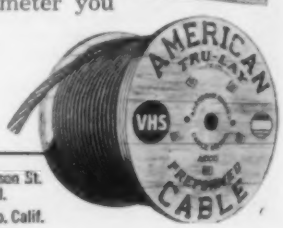
Wilkes-Barre, Pa.; Odessa, Texas; New York, N.Y.; Philadelphia, Pa.; San Francisco, Calif.

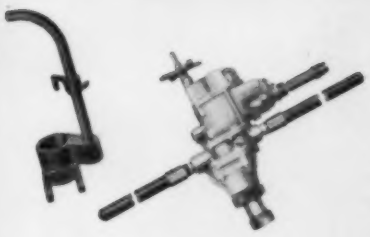


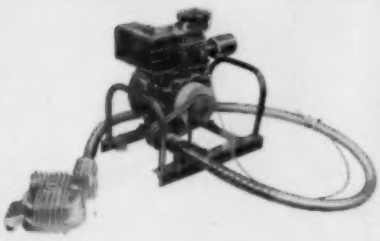
MUELLER®

C1-36 DRILLING MACHINE... WITH POWER DRIVE

saves time on pressure tie-ins

Make tie-ins into the system, even while under pressure, by drilling through tapping sleeves and valves, flanged tees or Save-a-Valve Drilling Nipples quickly, easily and safely with the power driven C1-36 Drilling Machine. Makes cuts from 2" through 12½" with boring bar travel of 36" controlled by automatic feed. Operating pressures range from 250 p.s.i. at 500° Fahrenheit to 500 p.s.i. at 100° Fahrenheit.





optional power drives

H-600 Air Motor Drive operates under full load with 90 cubic feet of air at 90# pressure, developing maximum torque of 470 foot pounds. Motor turns at 56 rpm under full load and will advance the boring bar 1" in 7⅓ minutes.

H-602 Gasoline Engine Drive equipped with centrifugal clutch that automatically picks up load as engine speed passes 1000 rpm. Governed engine speed of 2700 rpm drives Drilling Machine at 54 rpm, advancing boring bar at same rate as air motor.

Write direct for complete information and prices on the C1-36 Drilling Machine with power drive. We can show you how this machine and other related products can make fast tie-ins for you.

MUELLER CO.
DECATUR, ILL.
Since 1857

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario

"By far the best field

compressor on the market."

That's how Mr. John Walker of P. R. Rutherford feels about his Clark CFA packaged field compressor.

After three months of operation, P. R. Rutherford is so pleased with their first Clark CFA that they have ordered a second unit. Rutherford is using the CFA near Woodsboro, Texas, on gas lift service taking gas at 20-30 psig. and compressing it to 700 psig.

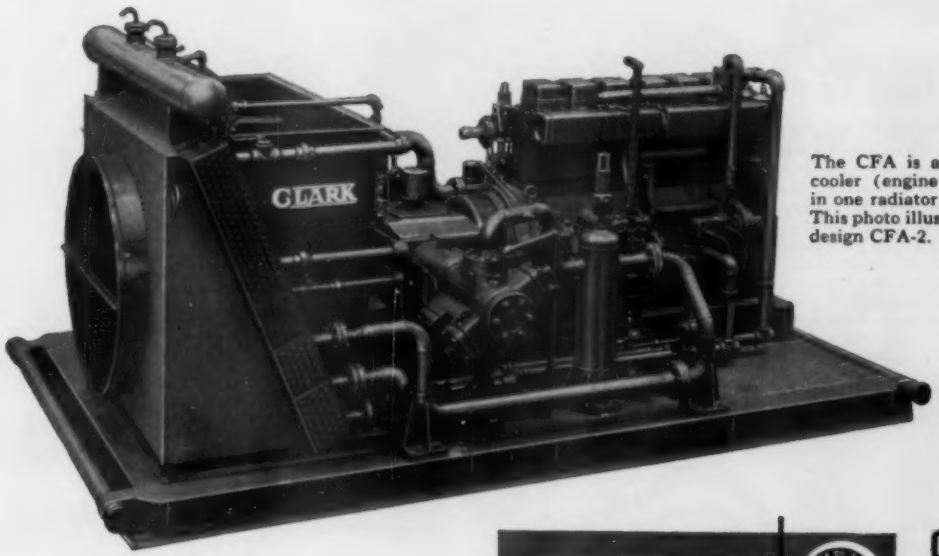
The CFA is a true thoroughbred with all components being designed for rugged field service. The compressor uses the balanced/opposed principle, made famous by Clark, to assure vibrationless operation. In the field, this means the CFA doesn't have to be tied down to a massive foundation. Just enough to level it is all that's required. The balanced/opposed design also permits high speed operation because there are no unbalanced forces. Operating at 1000 rpm., this five inch stroke compressor is *directly* coupled to a standard, proved design, oil field engine operating at the same speed. Drive belts and gears which can be a headache in remote locations, are not required. The engine and compressor together with a radiator for oil, water and gas cooling, is mounted on a rigid skid. The assembled unit is a compact, completely self-contained compressor station.

For tough field use there is only one modern, direct-connected unit available specifically designed for this service . . . the Clark CFA.

Two and four cylinder models are now available covering a horsepower range of 100-350 bhp.

The units are assembled, run-in and tested at the factory. They are ready to go when you receive them. Clark CFA specialists will give you all the facts.

CLARK BROS. CO. OLEAN, N. Y.
One of the Dresser Industries
Offices in Principal Cities Throughout the World

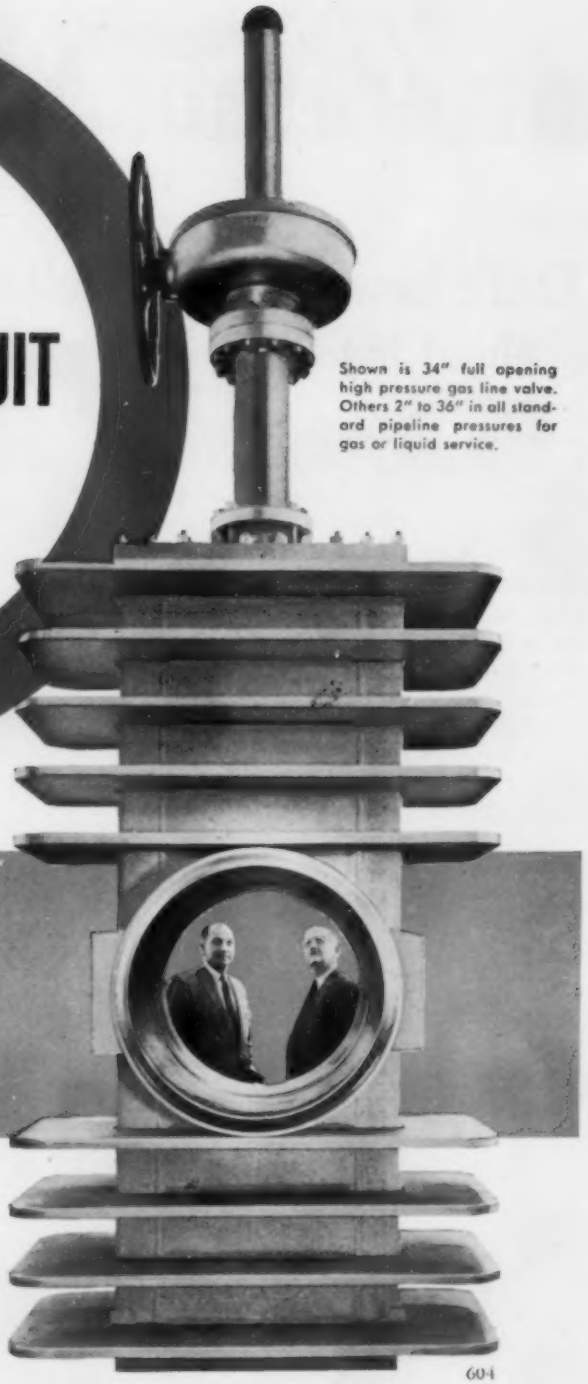


The CFA is available with a unitized cooler (engine and compressor cooling in one radiator) or individual radiators. This photo illustrates a 141 bhp. unitized design CFA-2.

CLARK®

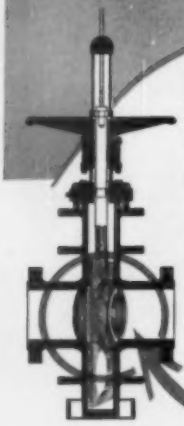
CFA packaged field compressors

the gate valve with THROUGH CONDUIT always in line with the line



Shown is 34" full opening high pressure gas line valve. Others 2" to 36" in all standard pipeline pressures for gas or liquid service.

- Solid one-piece parallel-faced gate always moves freely to the same precise full open or closed position
- No wedging to cause wear and consequent misalignment
- Nothing to impede free movement of line cleaning devices



THE WHOLE VALVE IS RIGHT HERE

When valve is full open or closed, bubble-tight seals on both sides of the gate completely isolate line pressure in the conduit. The body, serving merely as framework for operating mechanism and to prevent loss of product while gate is in motion, may be drained or vented to atmosphere when gate is open or closed. Integrity of seals can be checked any time by a tell-tale valve on the body.

604

GROVE SEAL-"O"-RING Gate Valves

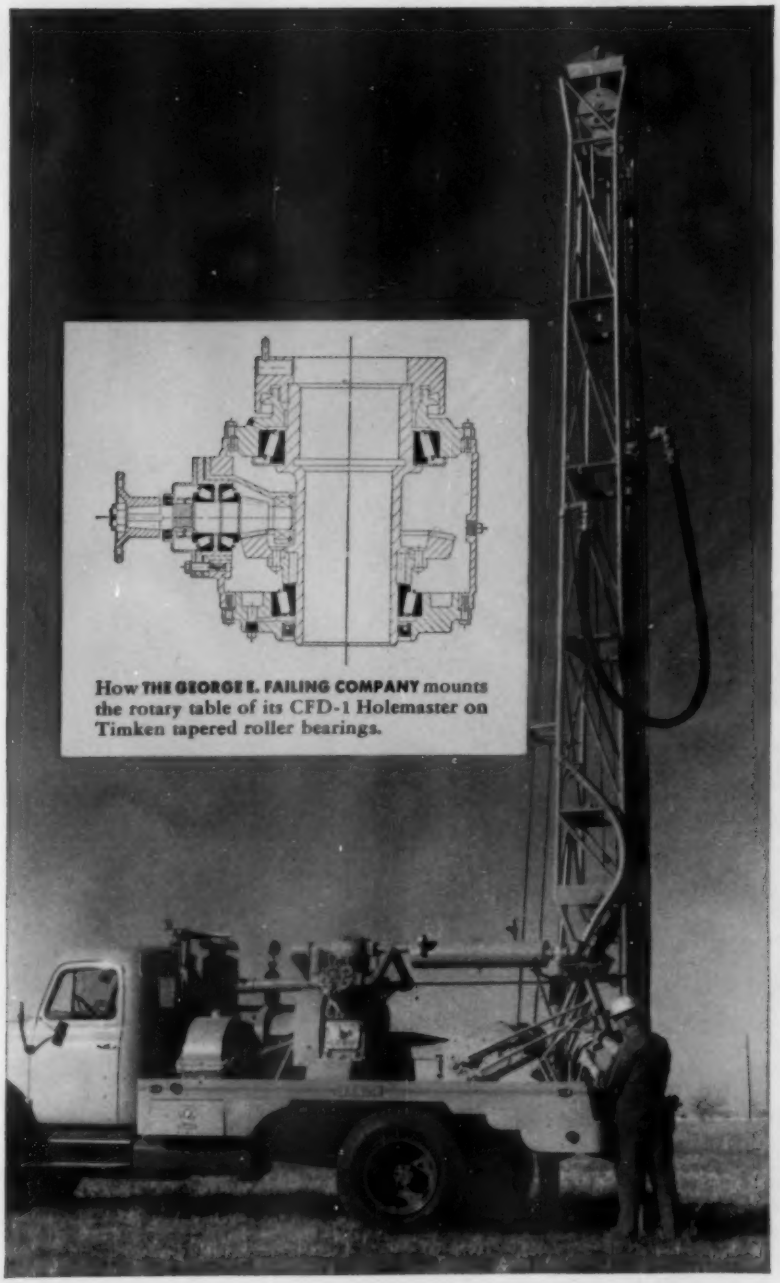
SUBSIDIARY OF WALWORTH

GROVE VALVE and REGULATOR COMPANY • 6529 Hollis St., Oakland 8, Calif.
HOUSTON 23—3517 Polk Ave. • • • • • LOS ANGELES 6—1930 W. Olympic Blvd.

GROVE SEAL O RING ® GROVE SIMPLICITY ACCURACY SAFETY

ODESSA, TEXAS • TULSA, OKLAHOMA • CHICAGO, ILLINOIS • DENVER, COLORADO • In Western Canada: GROVE VALVE LIMITED, EDMONTON

Portable drilling rig keeps on the go, with TIMKEN® bearings in gear case, rotary table and water swivel



How THE GEORGE E. FAILING COMPANY mounts the rotary table of its CFD-1 Holemaster on Timken tapered roller bearings.

ENGINEERED for speedy drilling, ease of operation and long life, this George E. Failing Company CFD-1 Combination Holemaster stays on its rugged work schedule with the help of 10 Timken® tapered roller bearings—in bevel gear case, rotary table and water swivel.

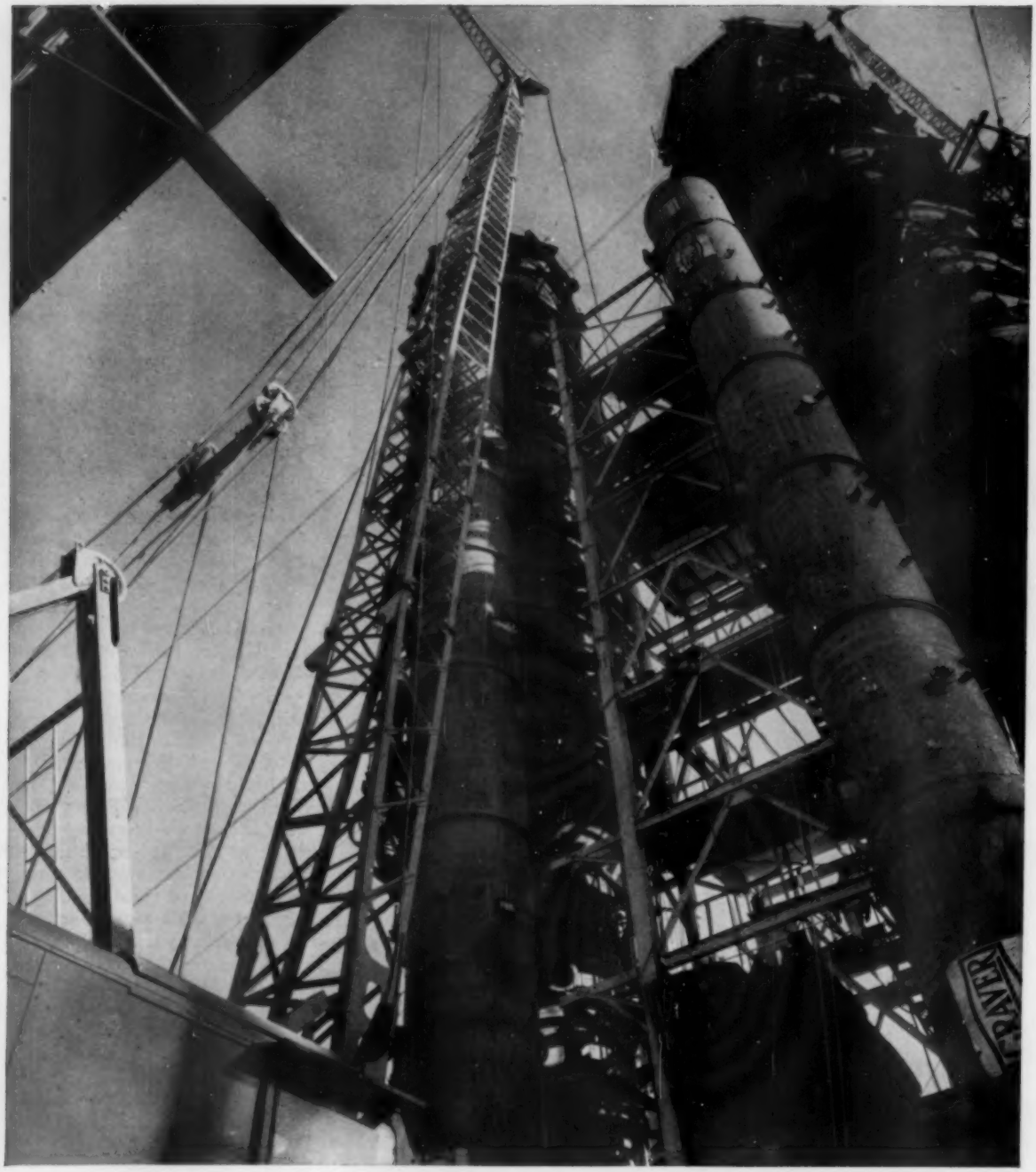
Timken bearings hold shafts in rigid alignment, let gears mesh smoothly, reducing wear and keeping maintenance down-time to a minimum. The tapered construction of Timken bearings lets them take radial and thrust loads in any combination. Case-carburized rollers and races—hard, wear-resistant surfaces over tough, shock-resistant cores—meet heavy shock loads. And by carrying the load over full lines of contact, rollers and races provide *extra* load-carrying capacity.

Geometrically designed and precision-manufactured to give true rolling motion, Timken bearings meet rigid quality controls from melt shop to finished bearing. We even make our own fine alloy steel to insure top quality—something no other American bearing maker does. When you buy or build machinery, look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN TAPERED ROLLER BEARINGS ROLL THE LOAD

TRADE-MARK REG. U. S. PAT. OFF.



NEW MONUMENTS TO EFFICIENCY!

These huge stripper columns were produced with typical Graver craftsmanship. Shop fabricated from ASTM A-285 Grade C firebox quality steel, they represent one of many types of processing equipment Graver has been fabricating for 100 years.

1857-1957 GRAVER® Our 100th Year

Building for the Future on a Century of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.

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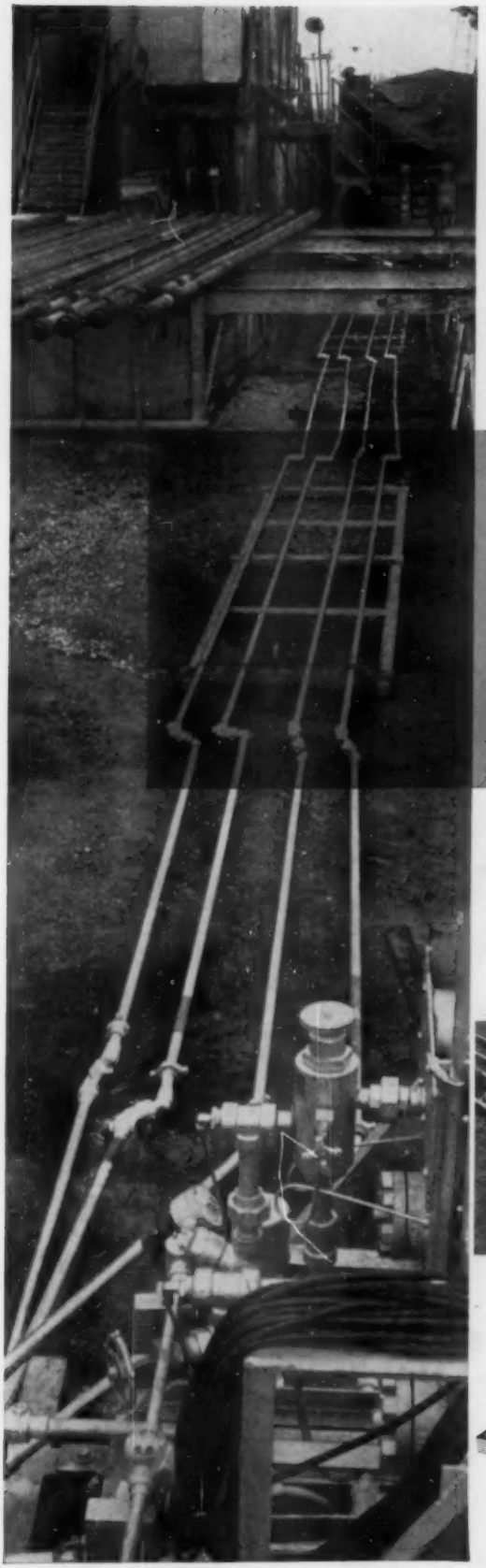
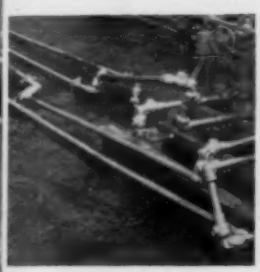


SWIVEL JOINTED ACCUMULATOR LINES CUT HOOKUP TIME 75%

SPOTTING SLED

OPENING LINES

HOOKING UP UNIONS



Situation: Connecting hydraulic piping from accumulator to blowout preventer on this California rig used to take two men well over two hours. There were delays for rethreading damaged pipe and replacing worn fittings. And keeping lines free of dirt between breakdown and rigging-up was a problem.

Solution: Searching for a faster hookup method, the veteran toolpusher in charge of the rig drew upon his previous experience with Chiksan Swivel Joints. By combining a series of Chiksan Joints with rigid piping mounted on a sled, one man now completes the entire hookup in one hour.

Benefits: The operators estimated that the savings in time alone more than paid for the Swivel Joints in less than a year. In addition to rigging time saved, wear and tear on the piping itself has been considerably reduced. And with line pressures of 1500 psi and surges up to 2000 psi, the free-swiveling Chiksan Joints absorb pulsation and vibration eliminating downtime required to replace leaky pipe fittings.

Where to buy: Chiksan Swivel Joints are available at your nearby supply stores in a full range of styles and capacities to meet every oilfield need. If you would like a drawing of the preventer line hookup described above, please write Chiksan, Brea, California, for "Bulletin ACL-1."

Free swiveling Chiksan Swivel Joints permit flexibility in positioning accumulator, absorb line pulsations and best of all, deliver years of service with only occasional maintenance.

Please Address Dept. 35.

fmc

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A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

CHIKSAN

CHIKSAN COMPANY—BREA, CALIFORNIA
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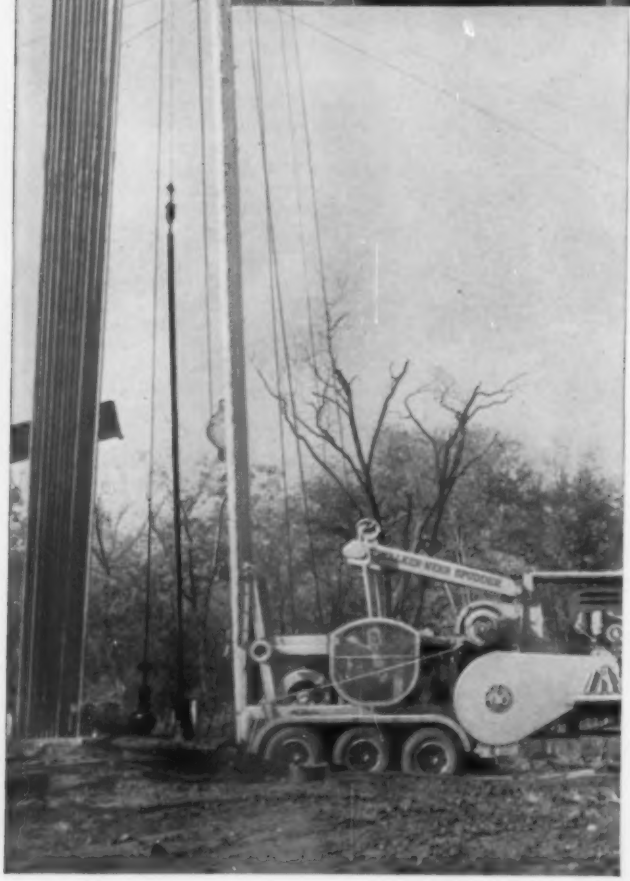
Well Equipment Mfg. Corp. (Division), Houston 1, Texas
Subsidiaries: Chiksan Export Company • Chiksan of Canada, Ltd.



For low upkeep...

REX®

Roller Chains

This Walker-Neer C-37 Spudder is working on a 5800-foot "frac" job near Countyline, Oklahoma. If you look carefully at the close-up view (with chain guards removed), you can count six chain drives—more exactly, six Rex Roller Chain Drives.

The revolutionary Rex system of pitch control assures equal load distribution over all parts, and a special Rex manufacturing process imparts tremendous extra strength at the pin holes—both important factors in long chain life.

These features, plus the easy assembly and disassembly of Rex Oil Field Roller Chains, mean minimum down time. Your wise choice for this exacting service is always Rex Roller Chain. CHAIN Belt Company, 4619 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT COMPANY

Milwaukee 1, Wisconsin

Oil Field Offices: Dallas • Houston • Los Angeles • New York
Export Offices: Milwaukee • New York

For out of stock Casing and Tubing call : IMPEX Ltd- CALGARY

experience in oil-country tubular goods and line pipe

F B T

FBT

The Comptoir F.B.T. groups the leading steel-pipe mills of France, Belgium and the Saar, employing more than 25.000 workers.

Comptoir Franco-Belge d'exportation des Tubes d'acier

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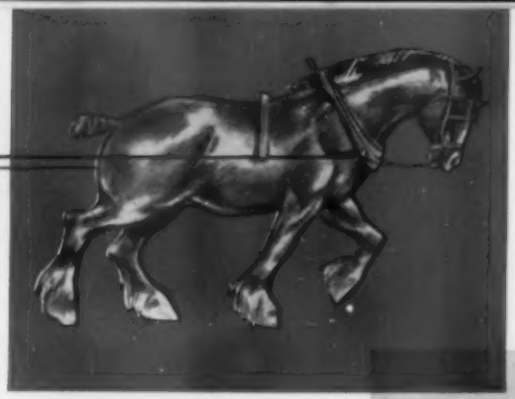
Cable address : Tubacier Paris



You get

MORE HORSEPOWER PER POUND

with

CONTINENTAL-EMSCO

SLUSH PUMPS

★ **HEAVY-DUTY PERFORMANCE**
Built like a giant, runs like a track star—delivers greater volumes and pressures per pound than any other slush pump.

★ **"EXPOSED" LINERS**
—are packed at both ends and completely exposed to view. This exclusive, patented feature eliminates all fluid washouts caused by liner packing failure since the slightest leak can be detected immediately.

★ **SUPERIOR CONSTRUCTION**
Wide-faced, forged-steel, heat-treated herring-bone gears, cast-steel, 8-pot fluid end, fabriform construction mean long service under tough conditions.

★ **AUTOMATIC LUBRICATION**
No greasing or adjustments are necessary. Lubrication is completely automatic.

On offshore drilling barges and platforms, in far-off desert and mountain locations, or close by at home, you'll find these popular, powerful Continental-Emsco Slush Pumps doing the mud pumping job better.

Distributors: Bovaird Supply Company, Tulsa, Oklahoma
Mid-Continent Supply Company, Fort Worth, Texas
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SP-7(

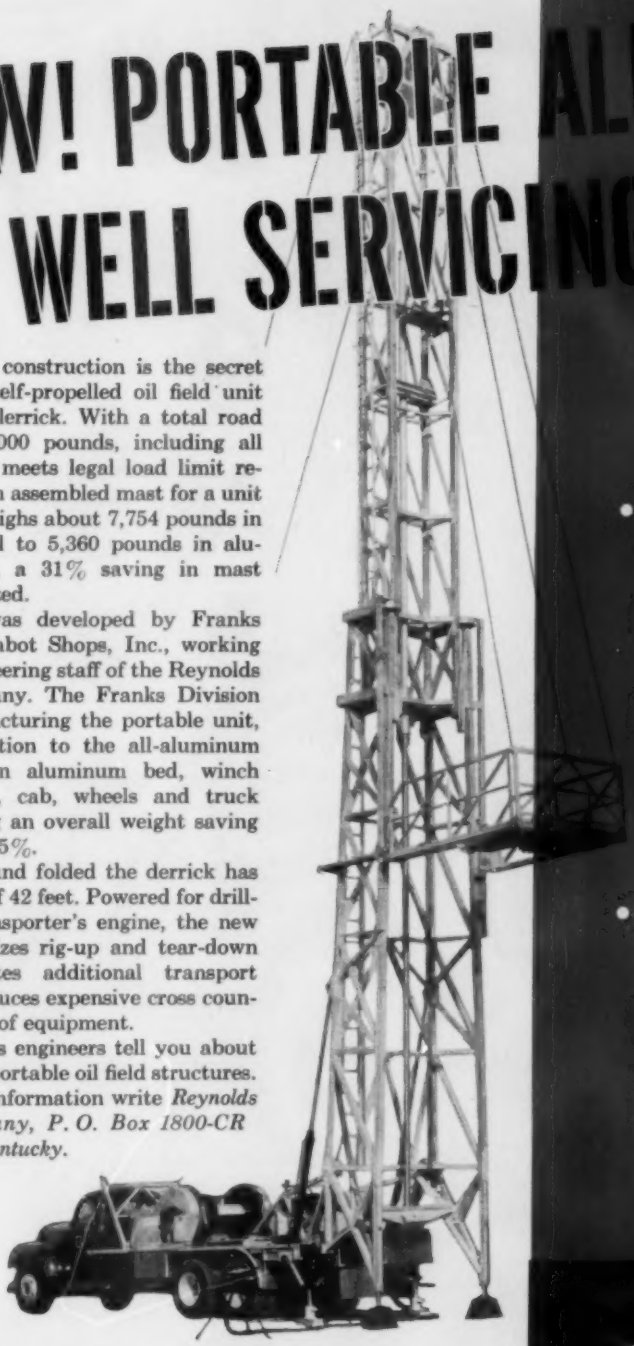
NEW! PORTABLE ALUMINUM WELL SERVICING RIG

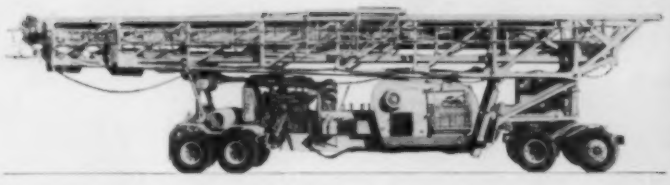
All-aluminum construction is the secret of this new, self-propelled oil field unit with 68 foot derrick. With a total road weight of 37,000 pounds, including all equipment, it meets legal load limit requirements. An assembled mast for a unit of this type weighs about 7,754 pounds in steel compared to 5,360 pounds in aluminum. Thus, a 31% saving in mast weight is realized.

The unit was developed by Franks Division of Cabot Shops, Inc., working with the engineering staff of the Reynolds Metals Company. The Franks Division is now manufacturing the portable unit, which in addition to the all-aluminum derrick has an aluminum bed, winch frame, guards, cab, wheels and truck bogie, effecting an overall weight saving of more than 15%.

Telescoped and folded the derrick has a road length of 42 feet. Powered for drilling by its transporter's engine, the new derrick minimizes rig-up and tear-down time, eliminates additional transport equipment, reduces expensive cross country movement of equipment.

Let Reynolds engineers tell you about aluminum for portable oil field structures. For complete information write *Reynolds Metals Company, P. O. Box 1800-CR Louisville 1, Kentucky.*





- meets legal road limit requirements
- reduces rig-up and tear-down time

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

See "CIRCUS BOY", Reynolds exciting dramatic series, Sundays, NBC—TV

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Tells you why NORTHWESTS are better on the Pipeline!

- Northwest Crawler design has been proved in miles of leap frogging on pipeline work. Northwest brings you dependable travel.
- Northwest simplicity of design makes upkeep easy in the far away spots that pipelines go through.
- The Helical Gear Drive from the engine, mounted on anti-friction bearings, enclosed and running in oil—gives long life and eliminates adjustments required with chain drives.
- The "Feather-Touch" Clutch Control gives power control of the main drum clutches without the complication of delicate mechanism such as compressors—pumps—valves or long lines of tubing.
- The Cushion Clutch eliminates shock overloads before they reach operating machinery—not after.
- Uniform Pressure Swing Clutches take the jerks and grabs out of swinging and assure smooth, safe, accurate fast spotting of loads.
- Northwest Dual Independent Shovel Crowd utilizes force that most independent crowd shovels waste—one of the outstanding reasons why Northwest Shovels are recognized everywhere as a *real* Rock Shovel.
- Cast Steel Machinery Bases and Machinery Side Frames give a rigid foundation that maintains shaft alignment and insures longer life and lower maintenance costs. Ball and roller bearings on high-speed shafts assure the maximum transmission of power.
- A wide range of equipment permits you to meet any crane condition. You can have worm boom hoists or independent high-speed boom hoists with power controlled lowering, removable counterweight, easy-lowering pivoted-type gantries and one, two or three load lines.
- Machines convertible to Pullshovel operation with maximum digging depths and reach. There is a wide range of dipper widths and dipper capacities to choose from. Northwest pioneered the Pullshovel and brings you a proved unit for rugged job conditions.
- Space does not permit telling the whole story. Ask for complete details. You can't get the Northwest combination of advantages anywhere else at *any* price.

NORTHWEST ENGINEERING COMPANY
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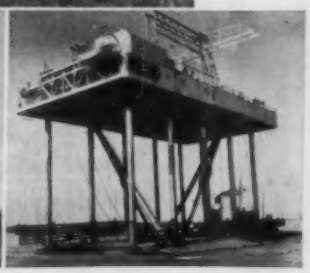
Mobile Type Drilling Rigs

giants of the depths
probing riches unlimited



Avondale offers you outstanding facilities for engineering, research and construction of all types of offshore rigs . . . and we know our business. We have built and are now building some of the most famous rigs in the nation. We are prepared to work with your Naval Architect, or to handle all engineering and research ourselves through the facilities of our vast and capable Engineering Department. You will find our prices competitive —our delivery dates firm. Before you decide on a builder for your next rig—see Avondale.

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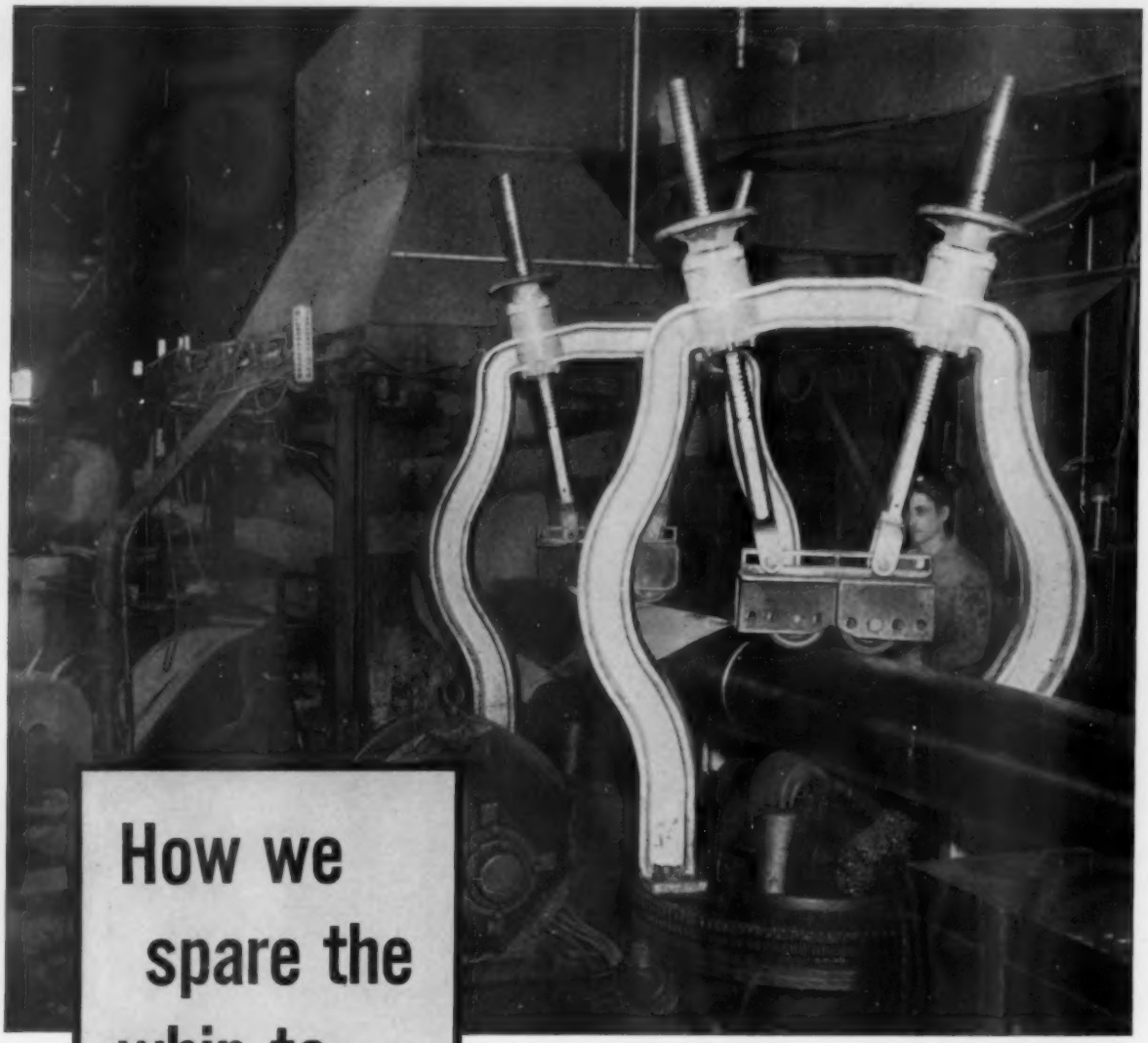


How we spare the whip to protect your pipe

You know how the bearings prevent crankshaft whip in your car. Hill-Hubbell took the same principle, adapted it to the pipe wrapping business. Thus the giant double yoke shown above, grips and steadies pipe as it is fed spirally into the coating-wrapping machine. This prevents whip, eliminates any irregularity in the thickness of the coatings or the tension of the wrappings. The "whip preventer" is another Hill-Hubbell first, another reason to—

Specify Hill-Hubbell wrapped pipe on your next job

HILL-HUBBELL & COMPANY

DIVISION OF GENERAL PAINT CORP. • 3091 MAYFIELD ROAD, CLEVELAND 18, OHIO

FACTORY APPLICATORS OF COATINGS AND WRAPPINGS

NEW WAY

to better buys

This tool pusher is considering and selecting operating parts and maintenance items. He's doing it at the place that's been specifically designed for careful, simple

Continued on next page

Continued from previous page

and efficient buying—today's National Supply Store.

Like other National customers, he gains several advantages by shopping in a National Store—and you can gain them, too.

The planned arrangement of counters, bins and warehouse areas makes it easy for you to personally select and compare before buying. The National Store personnel are ready to give you complete up-to-date information and prices on the items you're considering. They'll fill you in on field performance that other operators have reported.

Most important of all, here's where you can see and learn about new, proven items—products that may improve your present operations.

Today's National Supply Store carries stocks that have been carefully selected and tailored to the needs of your area. Items not normally stocked are quick-ordered and rushed to you—the result of one of the most modern communications systems in the oil country.

You'll find that the modern facilities and services available in National Supply Stores will help you operate more efficiently. Why not take advantage of the NEW WAY to better buys—stop in at the local National Supply Store tomorrow.

It's built to last the

National "Type E" Pumping Units are as rugged and dependable as modern engineering and manufacturing can make them! Every feature and part has been designed to give you maximum service with a minimum of maintenance. Here are a few examples:

- Extra strong main base with maximum rigidity and counterweight clearance for quick, easy floor level installation.
- Tough, hard alloy steel gears and pinions—gear train mounting and main bearings permit lower shaft loading and deflection—easily handles shock loads from load reversals.
- Stable, well-balanced samson post—rigidly cross-braced, built to distribute beam load evenly over entire foundation area.
- Simple Pitman components assure positive alignment and correct fitting—are easily field-serviced.
- Extra heavy duty walking beam and beam hanger for years of rugged service.

National's complete line of pumping units includes 22 standard API sizes plus various long stroke and portable variations.

Sizes range from the D-3SN-6DP having a 3200 lb. API Beam rating and 6400 in.-lb. API Gear Reducer rating to the D-32SB-456 DW with 32,400 lb. API Beam rating and 456,000 in.-lb. API Gear Reducer rating.

Get all the facts on National's complete line of Pumping Units today. New bulletins describing these quality units are available at the National Supply Store or from National representatives in your area.

These welders use a special, extremely accurate jig for samson post assembly. This is typical of the quality manufacturing operations performed at one of the newest and most modern oil field equipment plants in the U.S.-National's Gainesville, Texas, plant.

life of the well!

THE **NATIONAL SUPPLY** COMPANY

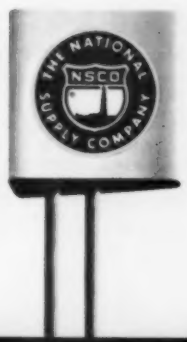
MAIN OFFICE: Two Gateway Center, Pittsburgh 22, Pa.

DIVISION OFFICES: Denver; Fort Worth; Houston; Toledo; Tulsa; Torrance

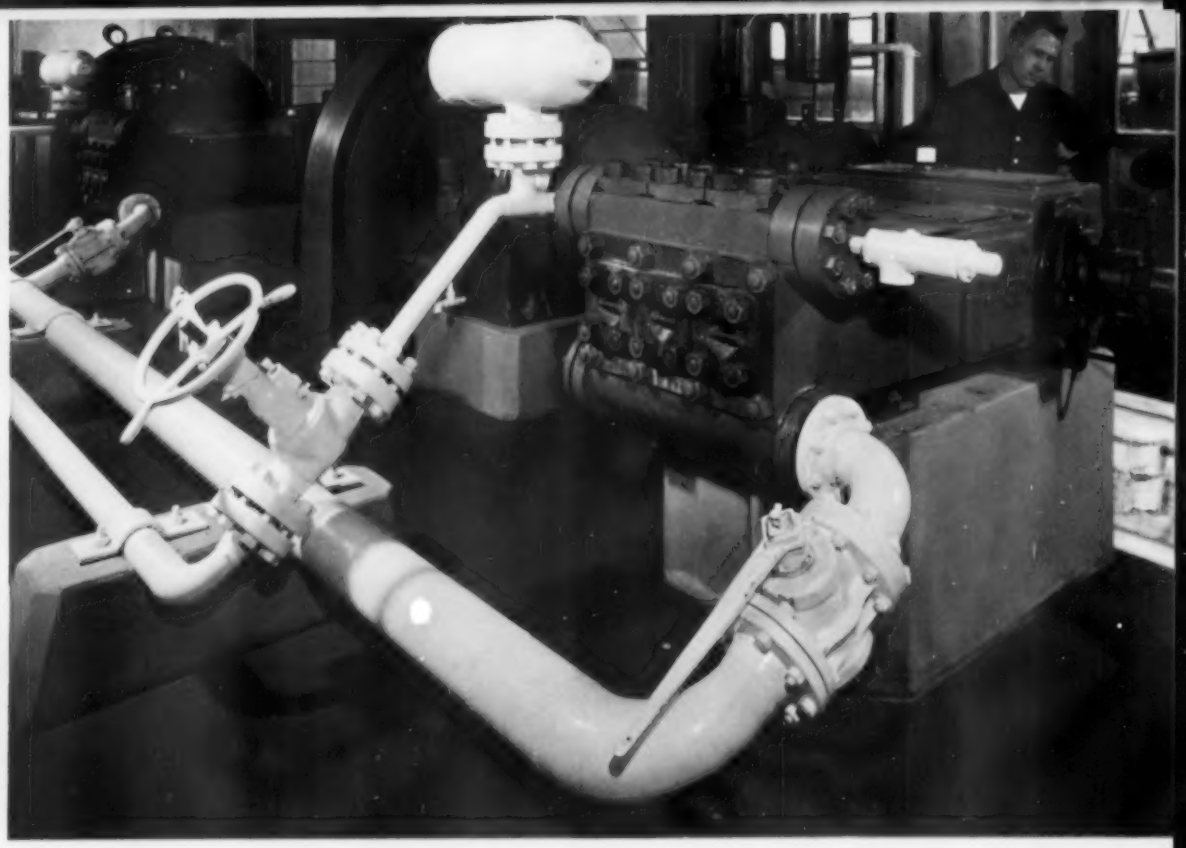
CANADA: The National Supply Company, Ltd., 200 F. W. Clark Building, 709 Eighth Avenue, West, Calgary, Alberta

EXPORT: 600 Fifth Avenue, New York 20, N.Y., U.S.A.; City Wall House, Chiswell Street, London E. C. 1

NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT



More National equipment for profitable production ...on the next page



For your special pumping jobs:

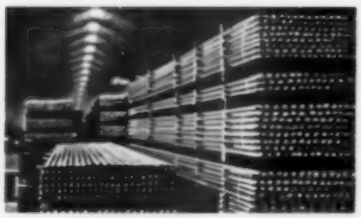
Rugged National Triplex Pumps!

Waterflooding is just one of the many jobs you can do profitably with National Triplex Pumps. They perform well on salt water disposal, high pressure testing, formation fracturing and acidizing, and as power-oil pumps for sub-surface hydraulic systems. Wherever you put them to work, they deliver dependably—with little service downtime.

National Triplex Pumps have heavy-duty frames and housings, long-life bearings, stainless steel valves, and National's time proven lubrication systems.

Plungers, fluid ends and stuffing boxes are interchangeable to meet varying pressure and volume needs and are available for either corrosive or non-corrosive service.

Check into all of the profitable features of National Triplex Pumps —the nearby National Supply Store or representative has complete information and bulletins for you.



Get reliable service from precision-made National Sucker Rods. They have top resistance to fatigue, shock, corrosion, and impulse loads. Available in a range of grades for every condition.

National Plunger Lift can be the best production method for certain types of wells. It uses formation gas or injected gas for operation. Ask your National Representative for details.

Interchangeable units provide many combinations to meet your specific needs in size, capacity, and type. Ease of assembly and pre-tested safety are two features of National Wellhead Equipment.

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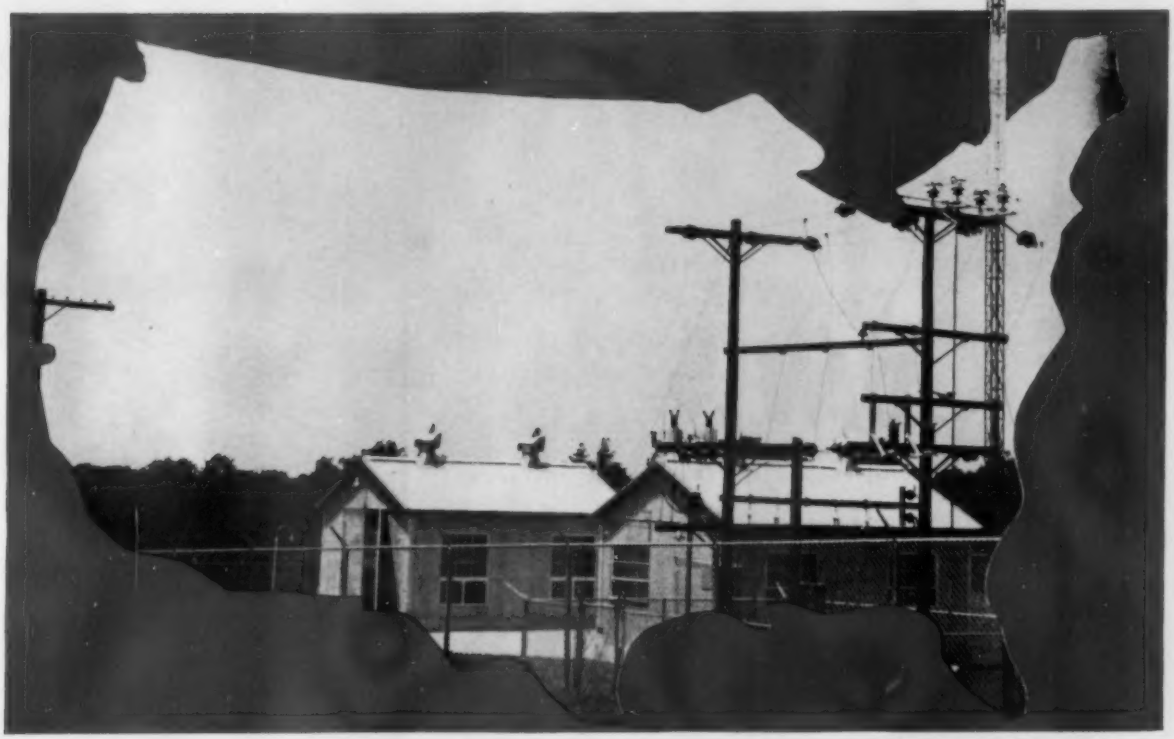
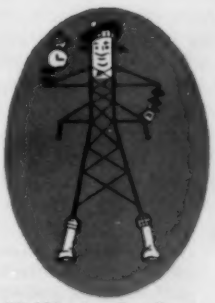
NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

ELECTRIC POWERED MICROWAVE CONTROLLED PIPELINE STATIONS NOW SPAN AMERICA...



One of many ways progressive management puts UTILITY ELECTRIC POWER to work

If you are in the pipe line transmission business . . . or if you contemplate having anything to do with pipe line transmission operations, don't sign any contract for power until you have carefully investigated the advantages of UTILITY ELECTRIC POWER. Of the 686,000 miles of pipe line systems in America, a big percentage of these is operated by Electric Power. When you have deliveries to make – at low cost – do it the modern, progressive way. Use UTILITY ELECTRIC POWER.



I'M LCP – Low-Cost Power on the Job 24 Hours Daily

PETROLEUM ELECTRIC POWER ASSOCIATION

P. O. BOX 2771 DALLAS, TEXAS

DISCOVER DAVIS

THE EQUIPMENT THAT LEADS THE WAY

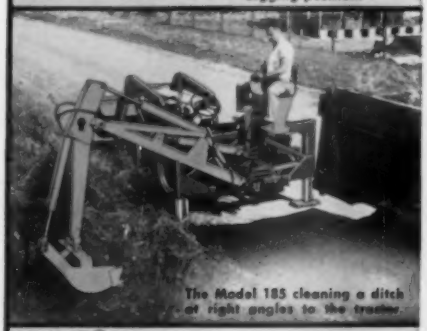
New Back-Hoes and Loaders for 1957 Make More PROFIT FOR YOU!

Here's a whole new era of profits for you. The new Davis 210 Back-hoe with three interchangeable mounting points so you can switch digging positions from center to side for flush digging alongside buildings, fences, etc....and its **exclusive hydraulic rotary boom swing cylinder** gives you a smooth, continuous 200° cushioned operating arc without ever changing a pin...an engineering achievement desired by all, but accomplished only by Davis. Both the new 210 and America's largest selling back-hoe, the Davis 185, have **7,000 pounds of breakaway** and new comfort design. They are both available as Davis' unique, low-cost, **truck-mounted back-hoes** that will fit any one-ton or larger flat-bed truck...compact in transport, self-powered, completely detachable. The popular **Davis Loader** has also been improved for greater utility...which means more profits for you in 1957, if you have Davis equipment.

Davis products are available for most popular tractors, and are sold and serviced anywhere in the United States and Canada by better dealers. See your dealer or write for literature. Please specify tractor and equipment you desire.

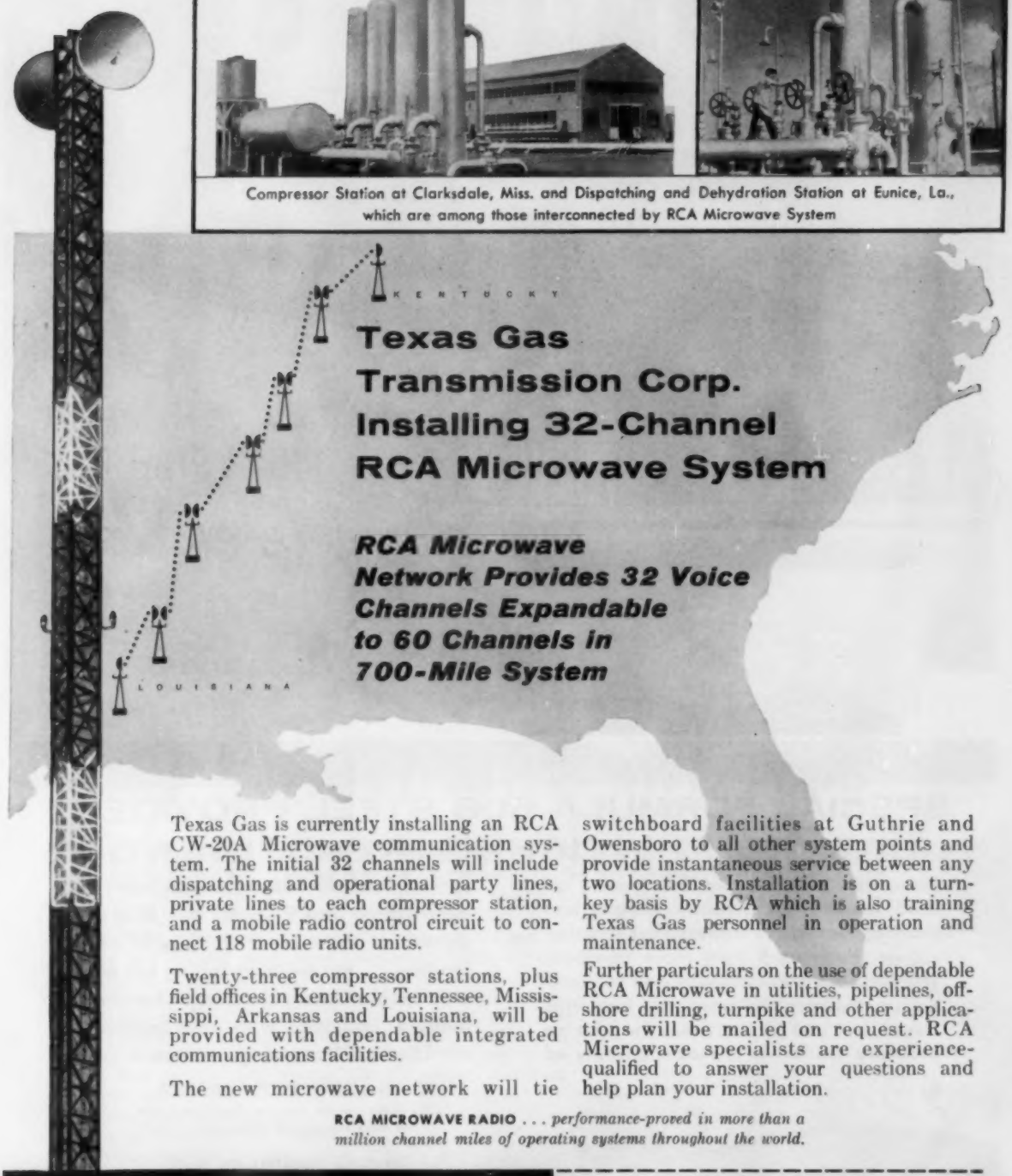
MID-WESTERN INDUSTRIES, INC.
1009 SOUTH WEST STREET, DEPT. OG
WICHITA, KANSAS

Davis Truck-Mounted Back-hoe from the transport to the digging position.


The Model 185 cleaning a ditch at right angles to the tractor.

The streamlined Davis Loader on John Deere 420 Crawler Tractor.

Compressor Station at Clarksdale, Miss. and Dispatching and Dehydration Station at Eunice, La., which are among those interconnected by RCA Microwave System



Texas Gas Transmission Corp. Installing 32-Channel RCA Microwave System

RCA Microwave Network Provides 32 Voice Channels Expandable to 60 Channels in 700-Mile System

Texas Gas is currently installing an RCA CW-20A Microwave communication system. The initial 32 channels will include dispatching and operational party lines, private lines to each compressor station, and a mobile radio control circuit to connect 118 mobile radio units.

Twenty-three compressor stations, plus field offices in Kentucky, Tennessee, Mississippi, Arkansas and Louisiana, will be provided with dependable integrated communications facilities.

The new microwave network will tie switchboard facilities at Guthrie and Owensboro to all other system points and provide instantaneous service between any two locations. Installation is on a turnkey basis by RCA which is also training Texas Gas personnel in operation and maintenance.

Further particulars on the use of dependable RCA Microwave in utilities, pipelines, offshore drilling, turnpike and other applications will be mailed on request. RCA Microwave specialists are experience-qualified to answer your questions and help plan your installation.

RCA MICROWAVE RADIO . . . *performance-proved in more than a million channel miles of operating systems throughout the world.*

RCA

Tmk(s) ®

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☐ Please send me latest literature on RCA Microwave.

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☐ Have RCA Representative get in touch with me.

NEW LOADCRAFT 808 OIL FIELD FLOAT

HIGH STRENGTH *Feather Weight*

HAS 50,000 POUND CAPACITY

SPECIAL FORMULA 808 STEEL PROVIDES ULTIMATE IN WEIGHT-STRENGTH RATIO

Now, here's an all new heavy-duty oil field trailer that actually weighs less than conventional trailers, yet it rated for as much as 5 tons more payload. This great buy will actually pay for itself with extra earnings from time and trips saved, but you pay no more than for an ordinary trailer. It is made entirely of special formula 808 steel with full 18" deep frame and 9" outer rail. It is designed for three point stability in nose loading . . . has oversize rolling tail pipe with self-aligning bushings for rear loading. Equipped with new Loadcraft combination bar-spring tandem.

A RUGGED PERFORMER

This baby has the guts for the biggest jobs. It has been scientifically designed . . . fully field tested.

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Dealer Inquiries Invited

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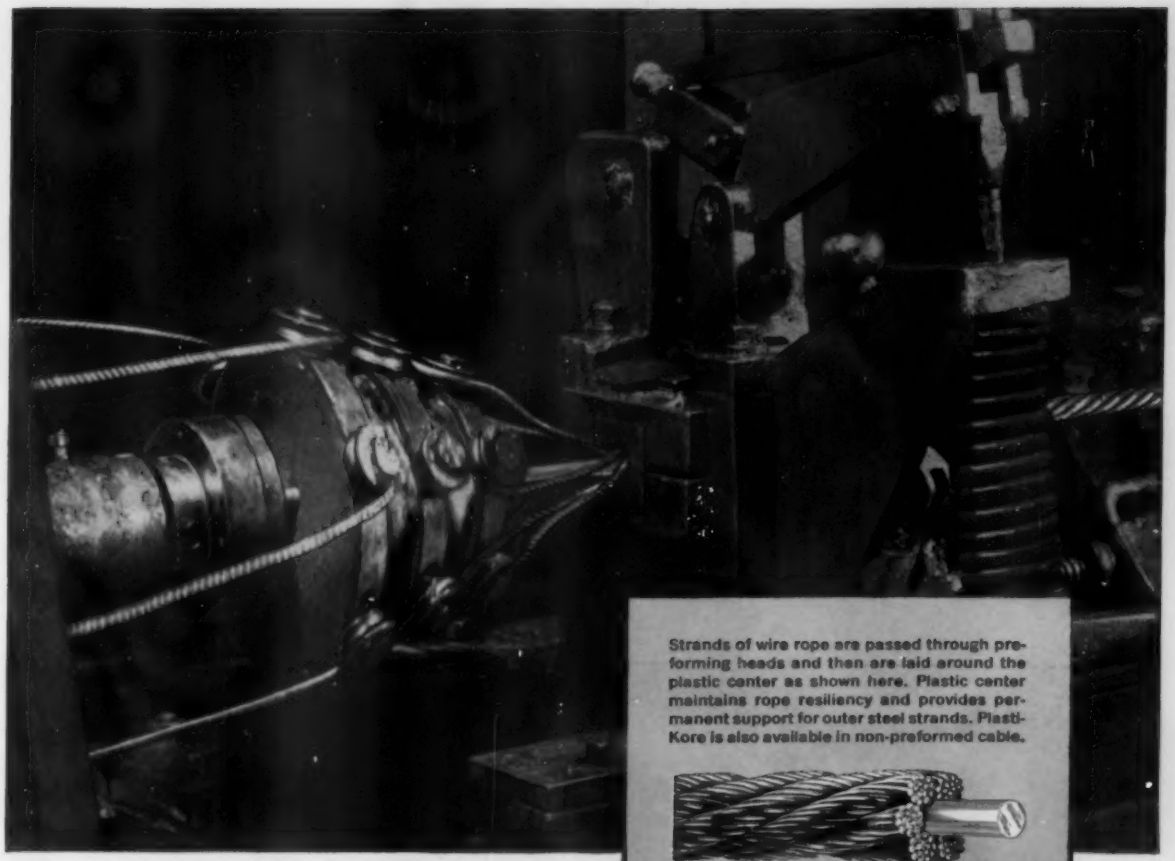
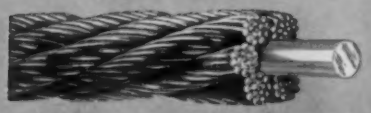


Strands of wire rope are passed through preforming heads and then are laid around the plastic center as shown here. Plastic center maintains rope resiliency and provides permanent support for outer steel strands. PlastiKore is also available in non-preformed cable.



why PLASTIKORE wire rope gives you real "snap action"

PlastiKore wire rope has many advantages for use as cable tool drilling lines, sand lines and swabbing lines. The plastic core provides a uniform strength and toughness throughout the length of the line. This results in flexibility with the "snap action" you want.

The plastic center is unaffected by acids, caustics, and water that destroy fiber cores. PlastiKore wire rope gives you long service life despite these rigorous operating conditions.

PlastiKore holds a uniform diameter in the high strain areas of the drum and sheave. Plastic center provides a uniform cushion for the outer strands and maintains strand clearance, thus preventing internal binding. Send coupon today for complete information on PlastiKore.

Jones & Laughlin Steel Corporation
Wire Rope Division
Muncy, Pennsylvania

☐ Please send literature on PlastiKore.

☐ Have representative call.

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Title_____

Company_____

City_____ Zone____

State_____

Jones & Laughlin STEEL

...a great name in steel

On more transmission lines and in more refineries than any other valve control

LimiTorque is the most widely used automatic valve operator in the World . . . Thousands are operating day and night, on Pipe Lines, and in Refineries, from Saudi Arabia to Canada. The wide preference for LimiTorque stems from proven performance under all service and climatic conditions: heat, cold, dust, fumes, sleet and rain . . . For all types of pipe line or refinery valves . . . LimiTorque can provide just the right control.

There is no guesswork or labor connected with the LimiTorque Valve Controls . . . from a conveniently located control point, one key man can open and close any type of valve quickly and dependably in remote or hazardous locations. Thus, vital pipe line and refinery operating procedure can be handled easily and safely. Also, LimiTorque provides protection from valve damage during closing due to the unique torque limiting mechanism.

LimiTorque may be actuated by any available power source, such as Electricity, Oil, Gas, Water or Air; and is now available for Microwave control.

Send for Catalog L-550 for details.

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PHILADELPHIA GEAR WORKS, INC.
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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

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MIDWESTERN'S stable of Corrosion fighters

KAPCO ROCK SHIELD · COROMAT · GLAS KOTE · GLASFAB BRAND WOVEN MEMBRANE · K

Midwestern's leadership in the field of pipeline corrosion control is the result of aggressive service practices, together with the most improved materials available . . . KAPCO Rock Shield — for pipe protection in rocky areas . . ."GLASFAB" Hot or Cold Dope Wrap — for emergency pipe line repairs . . . Owens-Corning Fiberglas CORO-MAT — for reinforcing enamel for lifetime protection of underground pipe . . . GLAS-KOTE handy tape for pipeline joint and fitting wrapping . . KEYSTONE Asbestos Felt — for high impact and soil acid resistance.

There's a Midwestern representative within a few hours of your pipeline requirements . . . wherever they are.

MIDWESTERN PIPE LINE PRODUCTS COMPANY

P. O. 1886, Tulsa, Oklahoma • Hickory 6-6144

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2 BIG REASONS WHY

MAJOR PIPELINES SELECT *Bingham* "DOUBLE VOLUTE" PUMPS

1 LOW MAINTENANCE. Bingham Pipeline Pumps are of "Double Volute" design, insuring perfect hydraulic radial balance of rotating element. "Hydraulic Radial Balance" eliminates unequal pressures on the rotating element—**"Side Push"**—which is the primary cause of wear and maintenance in conventional pumps. Also this feature, which eliminates shaft deflection, permits **mechanical seals** to establish and maintain uniform track between the contacting faces. This prevents leakage and seal face wear, resulting in *long seal life.*

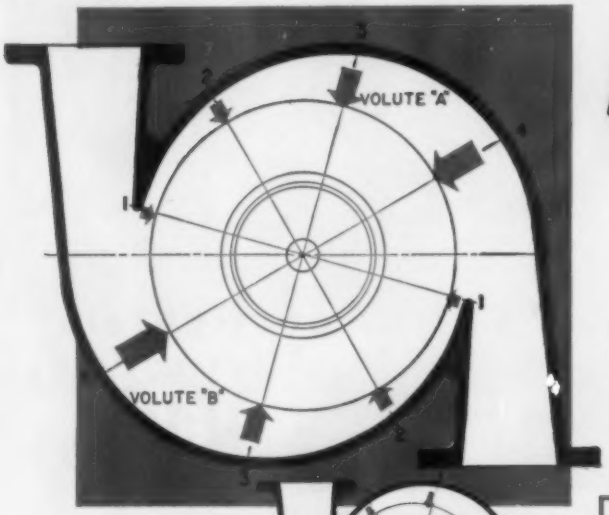


Diagram of a "Double Volute" double discharge case of a multi-stage pump (above) showing the equal pressure on the opposite sides of impeller. There is no "SIDE-PUSH"... insuring low maintenance.

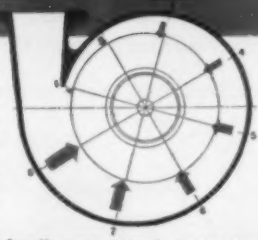
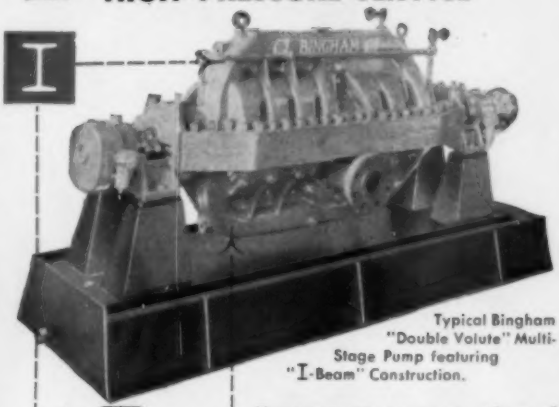
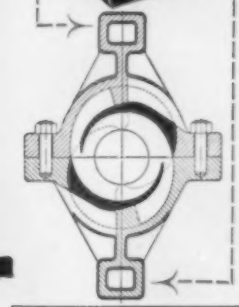


Diagram of "Single Volute" pump case (immediately above) showing unequal pressures at opposite points around the periphery of the impeller. These unequal pressures cause "SIDE-PUSH" on the rotating elements, causing wear of rotating parts and, frequently, high maintenance.

2 ASSURED CASE STRENGTH FOR HIGH-PRESSURE SERVICE



Typical Bingham "Double Volute" Multi-Stage Pump featuring "I-Beam" Construction.



Transverse cross-section of Bingham "Double Volute" Multi-Stage Pumps, showing identical cross-overs cast integrally with the upper and lower halves of the pump casing—**"I-Beam" Construction**—assuring case strength for high pressure service.

Write nearest Bingham office for "Double Volute" Bulletin, or additional information.

MAJOR PIPELINES USING BINGHAM "DOUBLE VOLUTE" PUMPS

ASHLAND OIL PIPE LINE
BRAZILIAN GOV'T PIPELINE
BUCKEYE PIPELINE
CHEROKEE PIPELINE
ESSO STANDARD OIL PIPELINE
FRONTIER OIL PIPE LINE
GREAT LAKES PIPELINE
INTERPROVINCIAL PIPELINE
INTERSTATE'S PIPELINE
KANEB PIPELINE
LAKEHEAD PIPELINE
MAGNOLIA PIPELINE
MINNESOTA PIPELINE
OKLA.-MISS. PIPELINE
PASOTEX PIPELINE
PEMBINA PIPELINE
PEMEX PIPELINE
PLANTATION PIPELINE
SERVICE PIPELINE
SOUTHERN PACIFIC PIPELINE
SPANISH AIR BASE PIPELINE
STANDARD OIL OF INDIANA PIPELINES:
1. DUBUQUE-MOORHEAD PIPELINE
2. MANDAN-MOORHEAD PIPELINE
3. WHITING-RIVER ROGUE PIPELINE
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Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: **2800 N. W. Front Avenue, Portland 10, Oregon**
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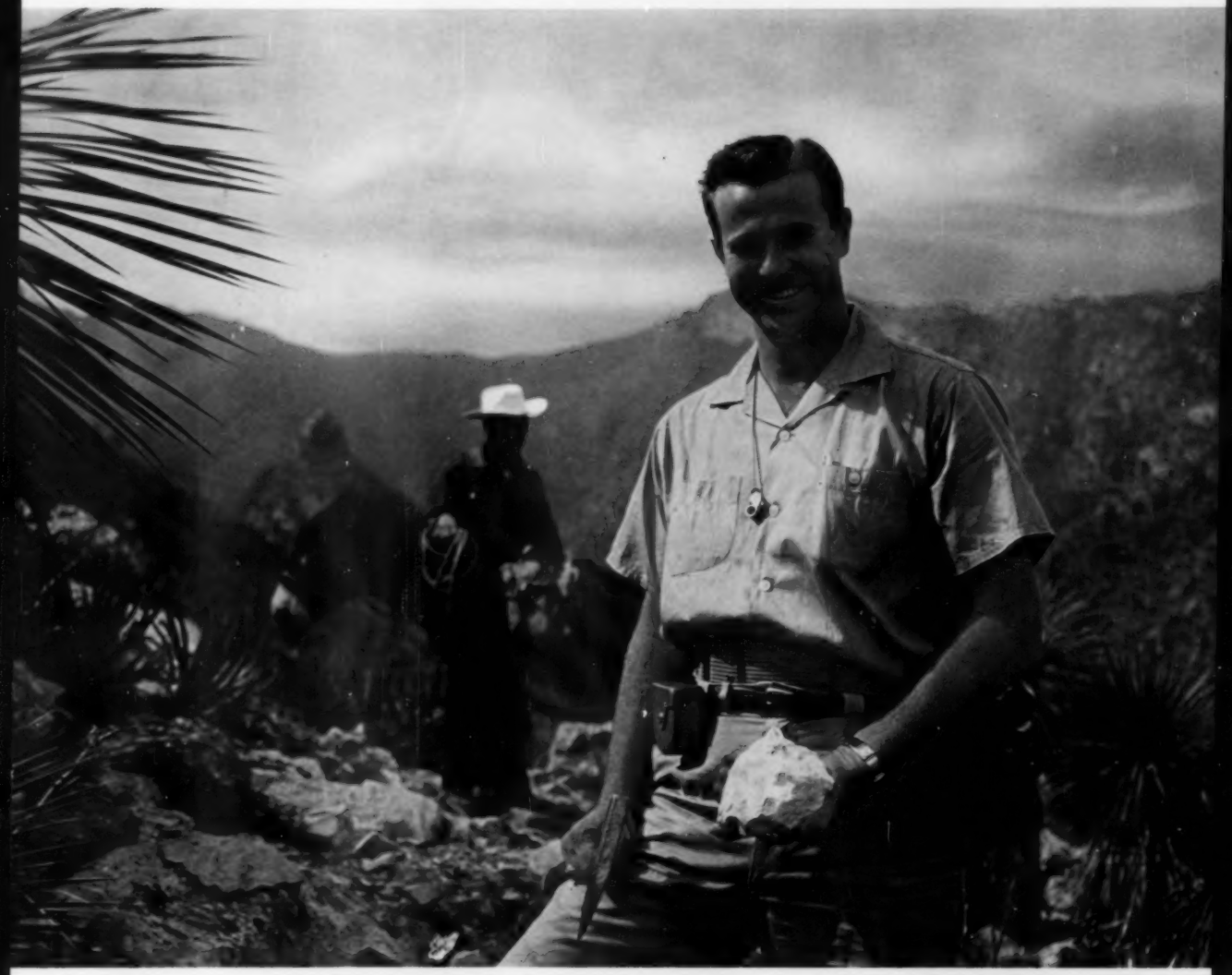
It takes a complete team to keep dependable drilling mud available for you



Meet this Magcobar Man, the geologist . . . he explores the world—and "moves mountains" to bring you drilling muds

The Magcobar Geologist works in all of the 48 states and many foreign countries—always on the look-out for useable mineral deposits.

What he finds determines whether or not there will be adequate mineral reserves available in years to come for safe, economical drilling muds.

What would happen if you couldn't properly "mud-up" your next drilling location? The Magcobar Geologist's job is to keep that from happening.

Magcobar Geologists are men you probably never will see—but if they were not on the job every day—all over the world—your future drilling operations might be greatly handicapped.

The Geologist is a vital part of the Magcobar team—the team that brings you the most complete mud service everywhere.

Magcobar
Complete
DRILLING MUD SERVICE

MAGNET COVE BARIUM CORPORATION

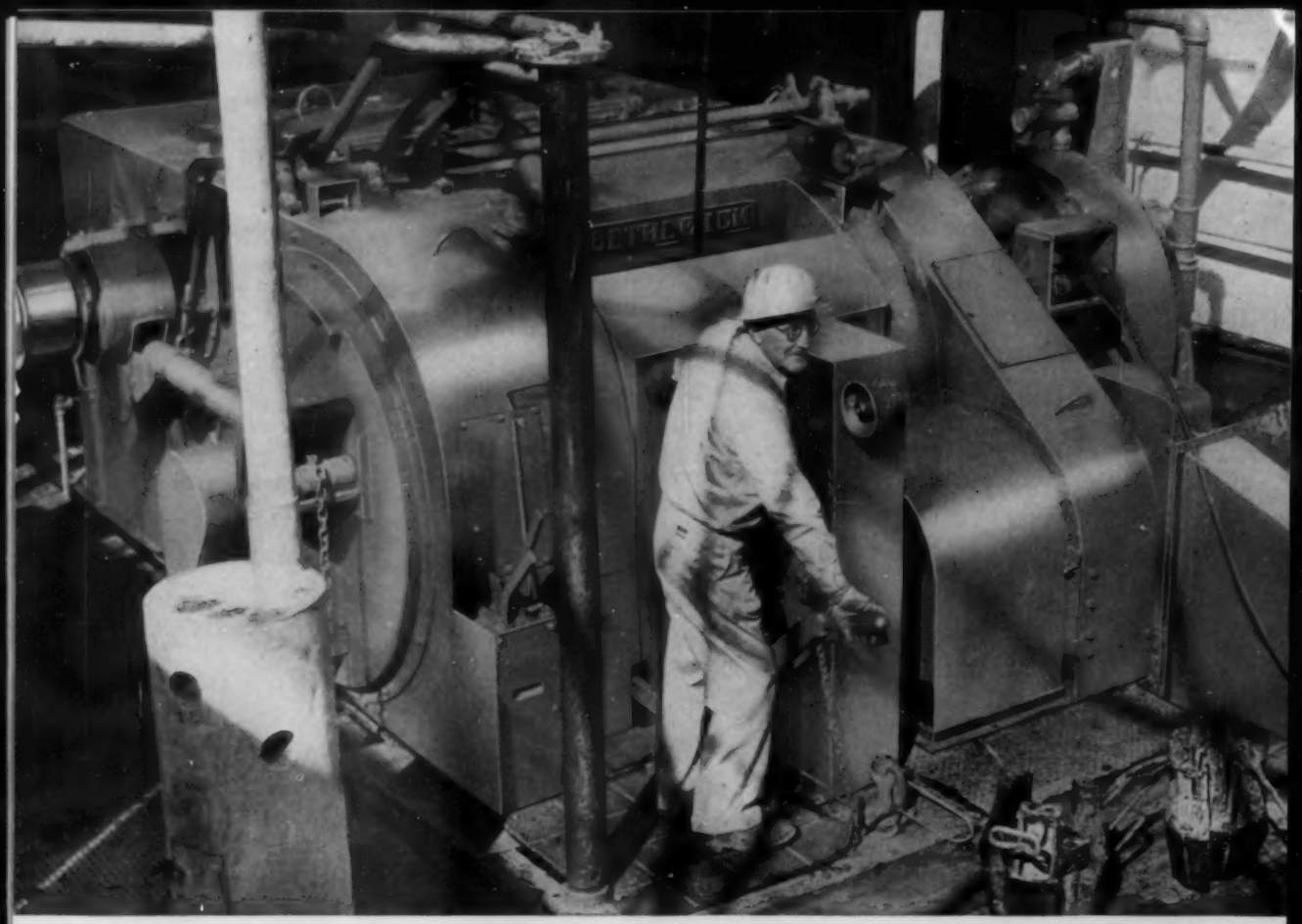
Houston, Texas

Roebling Royal Blue Wire Rope will **wear** and **wear** and **wear**!

This working quality means longer service life on *your* job. Add to this the fact that Royal Blue is stronger than the strongest rope you have been using and you have two excellent reasons why it has enjoyed faster acceptance than any wire rope in Roebling's history. Your distributor or Roebling Sales Office will give you the complete story, or contact John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Distributors, Branches and Warehouses Throughout the Country—Subsidiary of The Colorado Fuel and Iron Corporation



For Medium Drilling ... **The M-58**

For Medium-Deep Drilling ... **The M-810**

When jobs involve depths in the medium or medium-deep drilling ranges, Bethlehem offers two rigs that are second to none. They are unsurpassed in sturdiness, low cost of maintenance, and overall efficiency. Except in size, the units are much alike, both having the same basic design.

The smaller is Bethlehem's M-58; the larger is the M-810. Here are a few of their best-liked features:

M-58 — for holes of medium depth. Outstandingly high clutch capacity; low-speed drum clutch, 59,000 ft-lb torque at 100 psi air pressure. Oversized brakes, shafts, chains. Engine compound of sectionalized type; the rig can be broken down into loads of required road widths. Choice of drives: mechanical, hydraulic-coupling, or torque-converter. Upper drum provided as optional equipment when required.

M-810 — for medium-deep holes. This rig, like the M-58, is characterized by high clutch capacity (low-speed drum clutch, 102,000 ft-lb torque at 100 psi). Powerful 52-in. brakes for extra safety. Unit can be furnished with two- or three-engine hook-up having single or double pump drive. Engine compound sectionalized. Drives: mechanical, hydraulic-coupling, torque-converter. Upper drum optional.

Either of these rigs is a sound investment. You cannot make a better buy. On the basis of cost per foot of hole drilled, their records are impressive. Ask for full details.

BETHLEHEM SUPPLY COMPANY
General Offices: 21 E. Second St., Tulsa, Okla.
West Coast Headquarters: Los Angeles, Calif.
Canadian Distributor: Bethlehem Supply Company of Canada, Ltd. Calgary, Alberta, Canada
Export Distributor: Bethlehem Steel Export Corporation 25 Broadway, New York, N. Y.

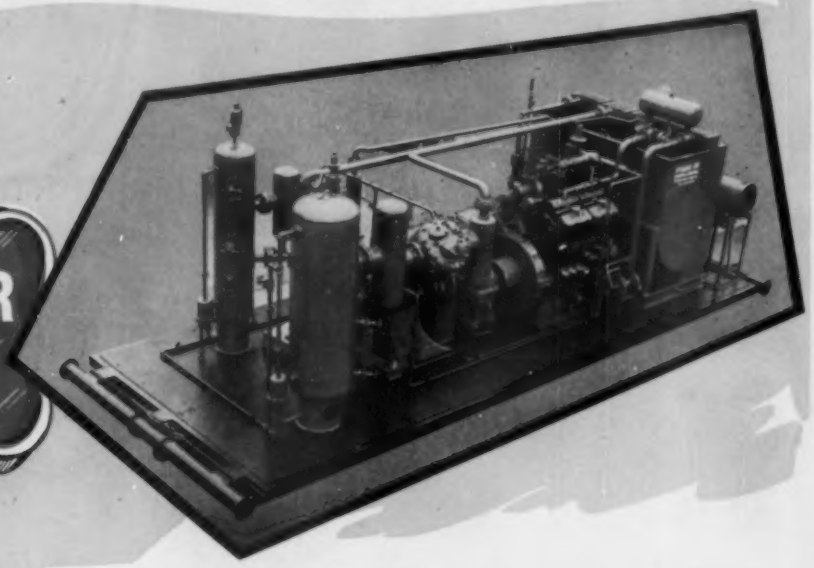
BETHLEHEM SUPPLY

BETHLEHEM STEEL

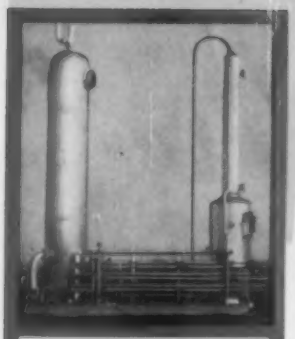
McNAMAR - JOY

for the **Best in Gas Boosters**

McNAMAR TULSA



● Pictured above is a McNamar - Joy WNB-112 twin cylinder gas compressor. This unit, located in the Rocky Mountains, is boosting 0.5 MMCFD gas from a suction of 15 psig, discharging at 800 psig.



McNAMAR SULPHUR EXTRACTION UNITS

McNamar's De-Sulphurization units assure dependable, economical operation and require minimum attendance. The completely packaged McNamar amine units are designed to sweeten the sour gas and make it a saleable product. Sufficient anti-corrosion measures are made to insure a longer maintenance-free plant operation.

The McNamar vertical air discharge cooler provides engine and jacket water cooling, also gas inter-cooling and after-cooling. It is a two stage, double acting, 200 horsepower compressor. The unit is direct connected through a gear reducer for minimum horsepower loss. Approximate weight is 24,000#. The overall dimensions are 7′ wide x 22′ long.

The complete unit is mounted on a single skid for compactness and ease of handling. The McNamar-Joy units are completely packaged with inner connecting piping, scrubbers, valves and safety controls and require only two connections to place in operation.

McNamar-Joy compressor units are designed to your individual applications and are available on *purchase, rental* and *rental purchase option* basis.

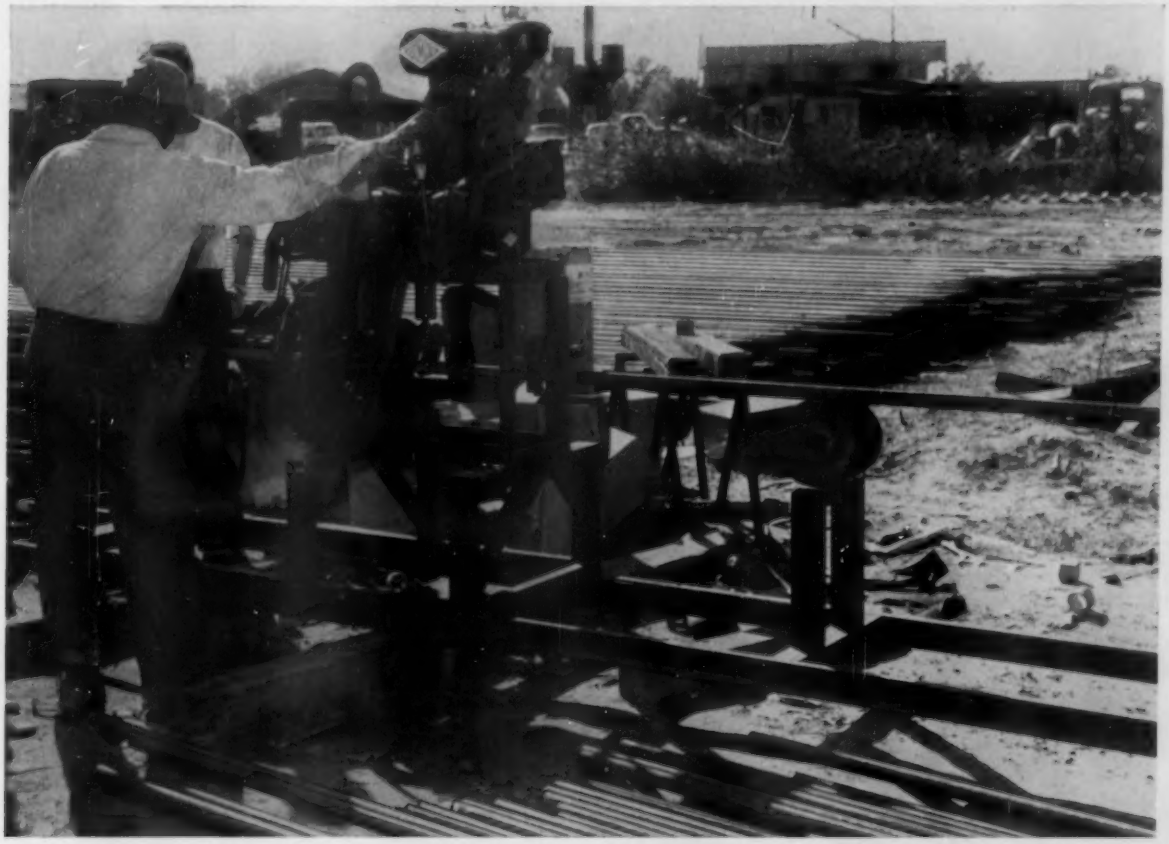
Call, write or wire McNamar for additional information.

McNAMAR BOILER & TANK CO.

McNAMAR TULSA

BOX 868 — TULSA, OKLAHOMA CHerry 2-6291

Entire gas distribution system site-wrapped with Polyken tape



A simple, inexpensive, mobile assembly of cleaner, conveyor and wrapper—coats over 10,000 feet of pipe per day with Polyken Tape and overwrap.

Arkansas Louisiana Gas Company chose this method because it's fast . . . it's simple . . . it's sure

While *Polyken* tape is making big-inch pipeline news, gas companies are also finding it ideal for yard or site-wrapping small-diameter pipe in local distribution systems.

Such was the case here, when the Arkansas Louisiana Gas Company used The *Polyken* Method for an entire system including the two cities of Gould and Grady, Arkansas. The installation was made by the Worth James Construction Company, who has used *Polyken* tape on various jobs over the last five years.

In the words of Mr. James, the outstanding feature of this method is that "it eliminates the need for a hot coat plant for small projects."

Tough, durable *Polyken* is applied, as you see, right off the roll—without heat, liquids, solvents or thinners. That saves time, labor and equipment costs. Later, because of the extreme versatility of the tape, welded joints can be simply hand-wrapped.

Want to figure application costs on your job? Write, wire or phone: The Kendall Company, *Polyken* Sales Division, Dept. OG-E. 309 W. Jackson Blvd., Chicago 6, Ill. (WEbster 9-7100).

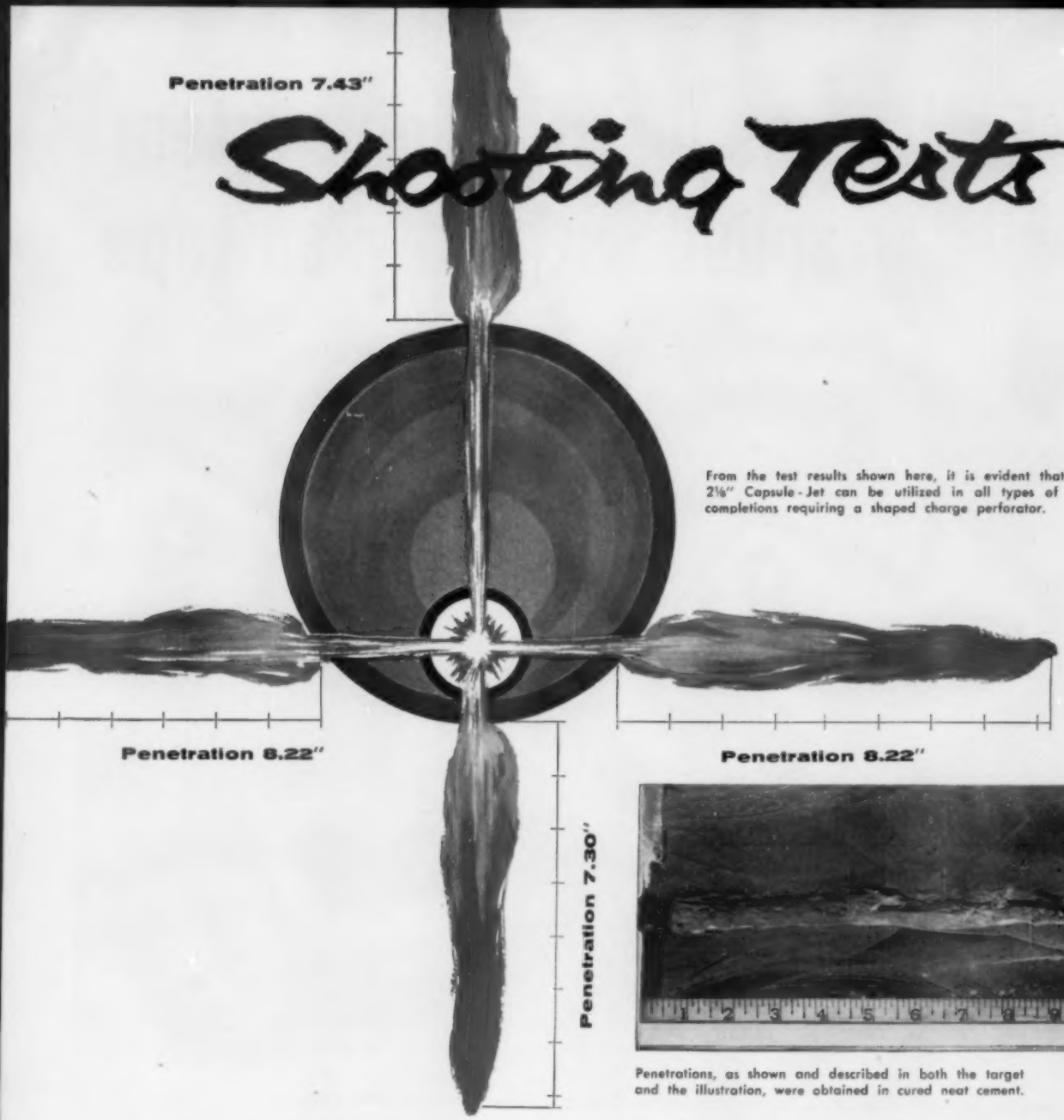
Complete catalog, Sweet's Industrial Construction File, Sec. 31/Ke

Polyken®

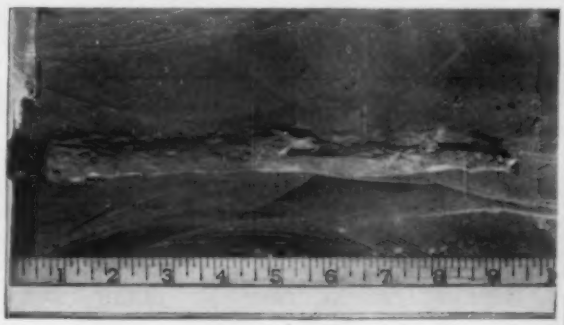
PROTECTIVE COATINGS

THE KENDALL COMPANY
Polyken Sales Division

Shooting Tests



From the test results shown here, it is evident that the 2⅛" Capsule-Jet can be utilized in all types of well completions requiring a shaped charge perforator.



Penetrations, as shown and described in both the target and the illustration, were obtained in cured neat cement.

CAPSULE-JET PERFORATIONS HAVE A HIGH FLOW RATE

The introduction of the expendable perforator by Schlumberger in 1951 opened an entirely new field of well completion practices. From the research and engineering laboratories of Schlumberger, now comes the latest and best in shaped-charge perforators . . . the New Capsule-Jet.

The Capsule-Jet is a thru-tubing expendable perforator in two sizes, 2⅛" and 1-11/16". The design features four or five shots per foot, phased at 90°.

This gun gives greater penetration than any thru-tubing perforator on the market and equals that achieved with the larger 4-inch carriers. The Capsule-Jet is designed to give its maximum formation penetration irrespective of the gun's position in casings up to 7½". This feature is important since the gun generally fires while lying on one side of the pipe.

The Capsule-Jet Perforator gives large, uniform holes to maximum penetration . . . holes that are even larger than the casing holes. The very shape of this perforation practically eliminates plugging—with either remnants of the charge or pulverized sand.

The new Capsule-Jet—with its deep penetration, large casing hole and large uniform formation hole—makes a perforation with superior flow characteristics, proved beyond any doubt in Schlumberger's high-pressure, temperature and flow laboratories.

Write for complete details or ask your Schlumberger engineer to give you additional information on *the best and most powerful thru-tubing gun in the field today!*

SCHLUMBERGER WELL SURVEYING CORPORATION

Schlumberger . . . Engineering for Better Service.

Prove Superior Charge Design

The NEW Schlumberger CAPSULE-JET PERFORATOR

For deep effective perforations that have a high flow index . . .
USE THE SCHLUMBERGER CAPSULE-JET

Check these other outstanding features . . .

Designed to give maximum formation penetration regardless of gun's position in the pipe.

Breaks up into small pieces, and will not obstruct further runs.

It leaves a minimum of debris—The debris from one foot of gun will fill only *one inch* of 5½" casing.

It is extremely flexible . . . allows easy handling of long sections of guns . . . will pass through kinks in the tubing.

It can be assembled with blank spacers to facilitate spacing of shots.

100 feet or 400 shots can be run on one trip in the well.

It can be run in pressures up to 12,500 p.s.i. and temperatures of 325°F.

It leaves no slug or debris in the perforation.

MINIMUM OF DEBRIS

The Capsule-Jet leaves a minimum of debris—just one-half the amount of the tubular guns. The capsule charge cases are made of a special die cast aluminum alloy developed by Schlumberger. The high strength and extremely low ductility of this alloy result in a case which withstands high pressures and has excellent break-up characteristics. The debris from this gun may be dissolved with the same ease as regular aluminum alloys.

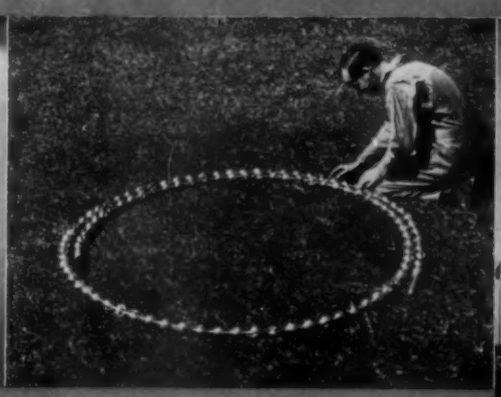
MAXIMUM FLEXIBILITY

The Capsule-Jet is designed with a minimum flexing radius of three feet. This flexibility allows the tool to be run through crooked or cork-screwed tubing without difficulties. Even though this tool is designed for maximum flexibility, charge case linkages are built for strength and durability. They will withstand a pull of 1000 lbs. without shearing.

LENGTHS UP TO 100 FEET

The Capsule-Jet gun can be run in lengths up to 100 feet. The flexibility of this gun will allow long sections to be fed into the riser assembly without the necessity of having to install a high mast or derrick on the well.

The debris from a 13-foot gun (52 charges) recovered from a well in Lea County, New Mexico. Two charges are shown for comparison.



Gun curved into a 3' flexing radius.

Capsule-Jet being fed into riser from the working platform of a portable derrick.

AN ENGINEERING ACHIEVEMENT BY

fish COMPANIES

HOUSTON, TEXAS

POWER FOR THE 1500-MILE PUSH . . .

from the prolific San Juan Basin to the gas-hungry Pacific Northwest

Construction of this Pacific Northwest Pipeline station, and the sprawling system of which it is part, posed some staggering problems—legal, financial and physical. Feasibility of the project was questioned for years. Some authorities said flatly it couldn't be done.

While the debate raged, however, the Fish Companies proved the feasibility, whipped the unique design problems, built the pipeline and helped form the utilities to take the gas. All with uncommon speed and engineering skill.

The greater scope of the Fish Companies—working together from conception to completion—can be of immense value to industries contemplating gas, oil or chemical facilities.

the fish companies

FISH ENGINEERING CORPORATION
FISH SERVICE CORPORATION
FISH NORTHWEST CONSTRUCTORS, INC.

They Say—

Profit in radioisotopes

"The known applications of radioisotope techniques have by no means saturated the market.

"It is estimated, for example, that the market for radioisotope thickness gages is less than 10 per cent saturated. It is reported that such installations, on the average, have been found to pay off the initial investment in less than a year—sometimes within a few months.

"Secondly, the application of low-level radioisotope tracer techniques to process control is just emerging. On bulk products, such as petroleum, sorting of shale from coal, etc., a net saving of a penny or two per ton of product could, if fully exploited, rapidly amount to millions of dollars a year."

E. Eugene Fowler, deputy director, Atomic Energy Commission, division of civilian applications, in a speech at the Industrial Nuclear Technology Conference.

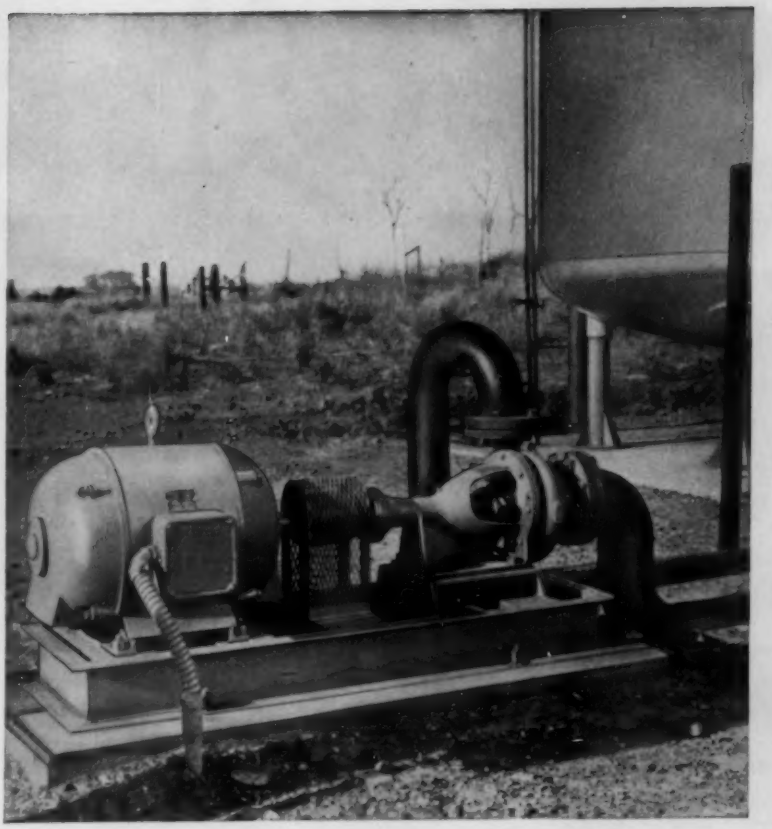
Sen. O'Mahoney on imports

"... I think the President's call for a voluntary agreement (to curb oil imports) amounts to nothing more than an invitation to the importing oil companies, which constitute only a portion of the American oil industry, to determine the policy of the United States Government . . . Nowhere in the Constitution do I find any authority to the President to delegate to a portion of a great industry the formulation of government policy with respect to the whole of that industry.

"Ever since the Trade Agreements Extension Act of 1955 was enacted, the Office of Defense Mobilization and the President have been attempting to secure some voluntary agreement among the importing companies. This attempt has been a complete failure. There is no reason to believe that it will be any less a failure now, even if it were lawful.

"These companies are represented to be in competition with one another. If they are to unite in an agreed-upon course of action they certainly must be granted immunity from the antitrust laws . . . In my opinion there is now no authority of law for the attorney general to grant such immunity . . .

"Recently . . . the attorney general filed a motion in the federal District Court at Alexandria, Va., asking the



A Centrifugal Pump Salt Water Can't Damage!

Ampco Pumps are ideal for salt-water disposal and flooding operations:

- *Transfer service*
- *Pumping over aerators*
- *Pumping through filters*
- *Back-flushing filters*
- *Delivery of treated water*

It's an AMPCO . . . made from aluminum bronze that contains no zinc.

Ampco Pumps resist corrosion, erosion, abrasion, cavitation-pitting, and dezincification. They are made from Ampco alloys engineered specifically to resist salt water corrosion.

Durability isn't the only advantage of Ampco Pumps. They have high efficiency . . . up to 85%. You pay considerably less for power.

Ampco Pumps are available in more than 100 different combinations, with speeds from 1750 to 3500 rpm; capacities to 600 gpm; heads to 300 feet.

Contact us in Milwaukee for the name of your nearest AMPCO PUMP DISTRIBUTOR.

AMPCO® METAL, INC.

Dept. OGJ-5, Milwaukee 46, Wis. • West Coast Plant: Burbank, Calif.

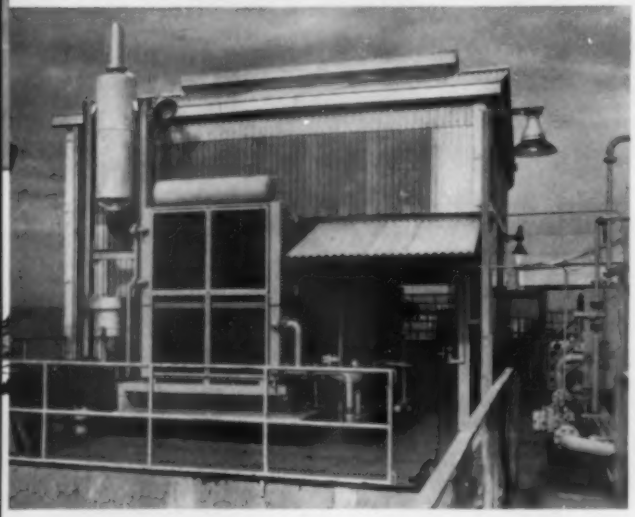
THE METAL WITHOUT AN EQUAL

P-23

Southwest

PACKAGED COMPRESSORS PERFECTLY BALANCED FOR PILING

Shell Oil Company — Block 35 — South Louisiana



FOR GAS LIFT, GAS BOOSTER, PRESSURE MAINTENANCE AND SIMILAR PROJECTS.

Here, in the Gulf of Mexico, this Southwest Packaged Gas Compressor, incorporating a Cooper-Bessemer GMXD-4 engine, compresses 4 million cubic feet of casing head gas per day from 350 to 900 psi. Proof that the perfect balance of the Southwest unit permits installation on any type of foundation. Pre-stressed concrete platforms, wooden piling, floating or submersible barges, are all the same to the rugged, perfectly balanced Southwest Packaged units. In addition to the economies of Packaged Gas Compressors, Southwest can deliver directly by barge from the Port of Houston to your location, eliminating costly rail-barge transfers.

The unattended operation, possible with the automatic controls and safety devices on Southwest Packaged Compressor Plants, cuts operating cost per horsepower-hour to a fraction of the cost of a fully attended stationary installation. A Southwest engineer can show you actual comparative operating costs. Available in sizes from 265 h.p. to 660 h.p.

SOUTHWEST INDUSTRIES, INC.

Post Office Box 7773, Houston 7, Texas

presiding judge to forbid the major U. S. oil companies from destroying records needed by the Department of Justice in the grand jury investigation it is now carrying on into price fixing in this oil industry. Surely it must be obvious that companies against whom the Department of Justice has found itself compelled to secure such an order are not to be trusted to make their own rules in this problem of imports."

Senator Joseph C. O'Mahoney, (D-Wyo.), in a letter to Gordon Gray, ODM director.

Import perils reviewed

"Unless imports are restrained, the domestic industry may very soon be carrying 30 per cent of its productive capacity shut in the ground for lack of a market. . .

"It is obvious that the imports-cost squeeze is taking a costly toll in oil unfound—oil that won't be developed and in the storehouse if and when we should need it in another emergency."

Lloyd Unsell, public relations director, Independent Petroleum Association of America, in a speech before the Panhandle Producers and Royalty Owners Association.

High risk in North Dakota

"At our current rate of net income from North Dakota production, it would take nearly 60 years to recover our North Dakota investment if there were no provision for interest. These are hardly odds that attract investors."

C. L. Larson, Jr., vice president and division manager, Pan American Petroleum Corp., in a speech before the North Dakota Bankers Association.

From defense to offense

"I've grown sick and tired of seeing businessmen take unfair legislative assaults lying down. I've grown sick and tired of seeing the demagogues go unchal'enged.

"We have been on the quiet defensive about these things too long. We have to move over to the offensive. We have to stand and fight for what we know is right.

"We have to learn the techniques of this thing just as we've learned the techniques of ordinary business. We have to learn how to state our positions on issues clearly, forcefully.

"This isn't easy—I know that. But no job in modern management is easy. We have to recognize that this is simply another facet of our obligation to protect our ability to make a profit. We have to recognize a very fundamental truth: Government can take our

SHIFTING LOADS CAN'T LOCK A LEBUS BINDER!

Look at the way this boomer opens—the handle swings the cam action *up, away* from the load! Even a shifted load jammed tight against the binder can't prevent a normal release. And a shifting load can't force a Lebus open because, once locked down, the handle won't open until *you* release it!

These important safety features are combined with exceptional strength in the 100% drop forged, heat treated Lebus Loadbinder. Exclusive swivel design makes connections easier, faster, safer through a drop forged ball and socket that won't pull apart regardless of the load. Deep flanges on the handle prevent spreading at the leverage point.

More than one million Lebus boomers have been sold—they're first choice of oil field truckers and heavy equipment haulers throughout the country. They know they're assured of safety when using pre-tested, fully guaranteed (under normal service) Lebus Loadbinders! Examine this boomer in use—you'll see it used everywhere in the oil fields—or make a point to see it, try it out. They're sold at leading distributors everywhere.

RIGGERS DEMAND GENUINE CROSBY "RED U-BOLT" CLIPS

Whenever wire rope must be secured with 100% holding power, *genuine* Crosby* Wire Rope Clips are specified! They're the work-proved symbol of safe, long life performance. For safety's sake ask for *—and be sure that you get*—the original, the genuine Crosby Wire Rope Clip—easily recognized by the Red U-Bolt*—the only clip that offers a *complete* range of sizes to fit every wire rope from ⅛ to 3" in diameter. *Registered Trademark

Stocked and sold by leading distributors everywhere

CROSBY LAUGHLIN DIVISION

SO. KEARNY, N.J. FT. WAYNE 1, INDIANA LONGVIEW, TEXAS

Let me tell you what MY boss thinks about...

J&L HIGH-STRENGTH CASING

We're drilling in off-shore and other deep-formation areas, so I hear a lot at the office these days about high-strength casing.

I'll tell you what MY boss thinks about J&L's N-80 and P-110.

First, he wants top strength pipe, and he likes J&L's method of heating the pipe and quenching with high-pressure injector-type nozzles.

Second, he likes the scientific accuracy with which J&L then tempers the casing to make it uniformly tough and ductile.

Third, and he says most important of all, he likes the co-operation he gets from J&L Supply men especially informed on high-strength tubular goods — men who have complete technical data on J&L seamless and can be really helpful, as in designing special casing strings.

J&L SEAMLESS CASING: Sizes from 4½" to 13⅜" O. D. Ranges 2 and 3. Grades H-40, J-55, N-80, and P-110. T & C with API threads. Buttress Thread and Extreme Line Joints also available.

J&L SEAMLESS TUBING: Sizes from 2⅜" to 4½" O. D. in T & C. Non-upset or external upset. Integral joint in 2⅜" and 2⅞" O. D. in grades J-55, N-80, and P-105.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

J&L — A GREAT NAME IN STEEL

32-S-2

business away from us even faster than our competitors can.

"It's up to us to stop the trend. That's simply another burden on managers, who already carry heavy business responsibilities."

Frank O. Prior, president, Standard Oil Co. (Ind.), in a speech before the Casper, Wyo., Chamber of Commerce.

News Letter a fine addition

Dear Sir:

I think that the letter that is appearing each week in the front of The Oil and Gas Journal is the finest contribution that has been instigated by you in a decade. It follows the same procedure that the United States News used and it was the one thing that made the United States News successful. I am very happy to see you carry this news letter.

Michel T. Halbouty
Consultant and
Independent Operator
Houston.

California's leasing terms

"In the opinion of Richfield, the California State Lands Commission should have the right to determine at the time it offers prospective state lands for lease whether such lands should be offered on the basis of a sliding scale royalty to be specified by the commission plus a cash bonus to be bid, or to offer it on the basis of a bonus to be specified by the commission (say $500 per acre) plus a sliding scale of royalties to be bid . . .

"Proper exercise of such authority would work out more equitably and fairly to all responsible elements in the oil industry than a flat 16⅔ per cent rate of royalty plus bonus to be bid . . . The royalty rate of 16⅔ per cent plus a large cash bonus eliminates all but the largest producers, and we do not believe this is either to the interest of the industry or of the state."

Charles S. Jones, president, Richfield Oil & Gas Co., in a letter to the Western Oil and Gas Association.

Oil lift in retrospect

"The oil supply crisis, created by the stoppage of the Suez Canal and the sabotage of Iraq Petroleum Co.'s Middle East pipelines, has now passed into history . . . It is now possible to assess with some perspective the dimensions of the crisis, the problems it created, and the success of efforts to deal with them . . .

"Recognition should be given to a job well done. To be sure, the functioning of the oil lift was not perfect or devoid of controversy. It could hardly be expected to be, considering the

No. 107 Globe Valve

No. 1250 Gate Valve

No. 912 Globe Valve

No. 830 Stop Cock

No. 1296 Gas Cock

No. 840 Quick Operating Valve

DEPENDABLE

D.T. Williams VALVES

are now produced by

DETROIT CONTROLS

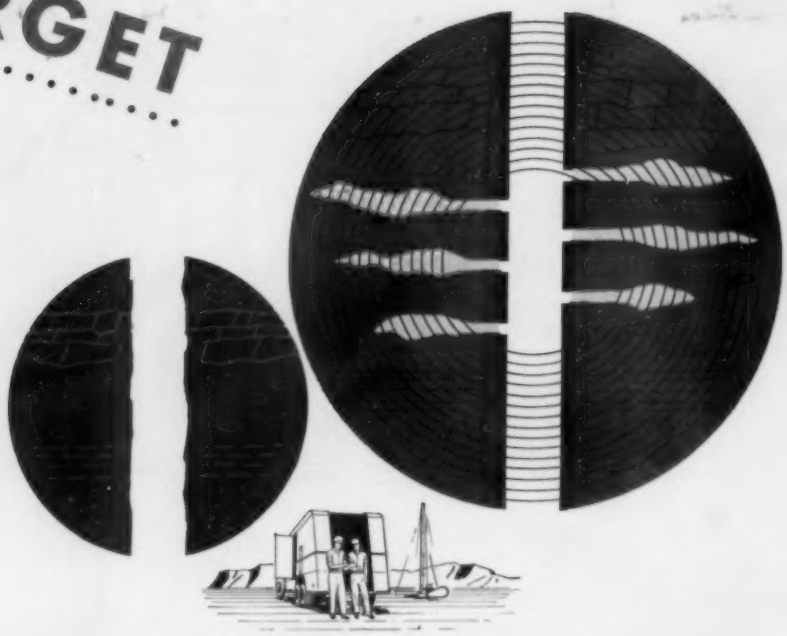
GUARDIANS OF THE PIPELINES
D.T. Williams VALVES

This new association serves only to assure users of D. T. Williams Valves continued high quality and good service in the future as in the past. Direct orders and correspondence to D. T. Williams Valves, Detroit Controls Corp., 5801 Mariemont Ave., Cincinnati 27, Ohio.

5900 Trumbull Avenue
Detroit 8, Michigan

DETROIT CONTROLS
CORPORATION
Division of American-Standard

ON TARGET



Halliburton's logging guides primary cementing to bullseye placement

Here is a typical sequence of operations with which thousands of oilmen have successfully set up targets of production with Halliburton Electrical Well Services —then hit the target with Halliburton Cementing Services:

(1) Run Halliburton Electrical Log in open hole to locate producing horizon.

(2) Run combination contact and caliper log for quantitative evaluation of producing area.

(3) Perform Halliburton primary cementing job, using caliper log data to guide placement of centralizers and wall cleaners, and to compute needed volume of cement.

(4) Verify height of cement top with Halliburton Temperature Log.

(5) With Halliburton Radioactivity Log and Casing Collar Locator, pinpoint exact interval of producing formation to be perforated.

The benefits to your operations that result when related services support each other is a logical reason to call Halliburton for BOTH Logging and Cementing.

HALLIBURTON

OIL WELL CEMENTING COMPANY, DUNCAN, OKLAHOMA

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG

"TARGET-SEEKING" PRODUCTS FOR BETTER CEMENTING BY HALLIBURTON

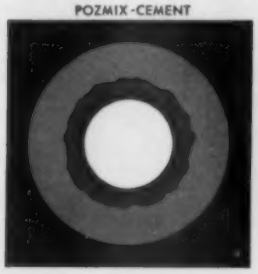
SUPER-SEAL FLOATING EQUIPMENT

Halliburton's Super-Seal Float Collar and Float Shoe "float" and guide casing string into bore hole. Also reduce possibility of contamination around outside of bottom joints. Super-Seal Floating Equipment has more than twice the sealing area of usual ball-and-seat valves, aiding positive shut-off against back pressure.

"DV" MULTIPLE-STAGE CEMENTER

For primary cementing on outside of casing string. "Targets" of Application for this versatile tool include full-depth cementing, cementing off formations at any point, reducing channeling, reducing pump pressures, dual zone well completion, and preventing loss of cement slurry to thief formations. Designed for positive fluid shut-off by means of hydraulically operated dual sleeves and high-pressure packing. Tested for strength to withstand pressures up to collapsible strength of casing with which used.

POZMIX-CEMENT



POZMIX-CEMENT

Halliburton's high-performance cement is superior to conventional portland cements....it is resistant to sulfate and salt water corrosion. Pozmix-Cement is also lower in cost, easier to pump, easier to perforate, less permeable, more durable. Has been used with greater success in thousands of cementing jobs. Wide variety of accelerators, retarders, fluid loss and weight control additives provide precision control and excellent results for the widest range of cementing problems.

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"A WELL THAT'S WORTH CEMENTING... IS WORTH CEMENTING WELL!"

NEW TWIN DISC Air Operated Friction Power Take-Off

A new air-operated Friction Power Take-Off has been added to Twin Disc's extensive line of friction clutches. Among other advantageous features, it incorporates the time-tested and popular Twin Disc Model PO Air Clutch for the engaging and disengaging mechanism.

Available for engines rated up to 600 hp, the new PTO offers the advantage of remote-controlled engagement and disengagement through a light touch on a control valve handle . . . thus it is particularly desirable for oil well drilling rigs where the operator must work from a remote driller's platform.

Full engine torque is available through the PTO with only a few cubic inches of compressed air. Normally air at 90-100 psi is adequate but 130 psi can be used if required. Actuating air to the clutch enters the PTO through a drilled passage in the output shaft.

The new PTO's are built to SAE standards. Present designs are completely interchangeable with 18-inch single and double-plate Twin Disc PTO's and are furnished with SAE 0 and 00 flywheel housing sizes. The same basic shaft is also used, with slight modification, to permit lubrication of the pilot bearing from a point other than the usual drilled passage at the output end.

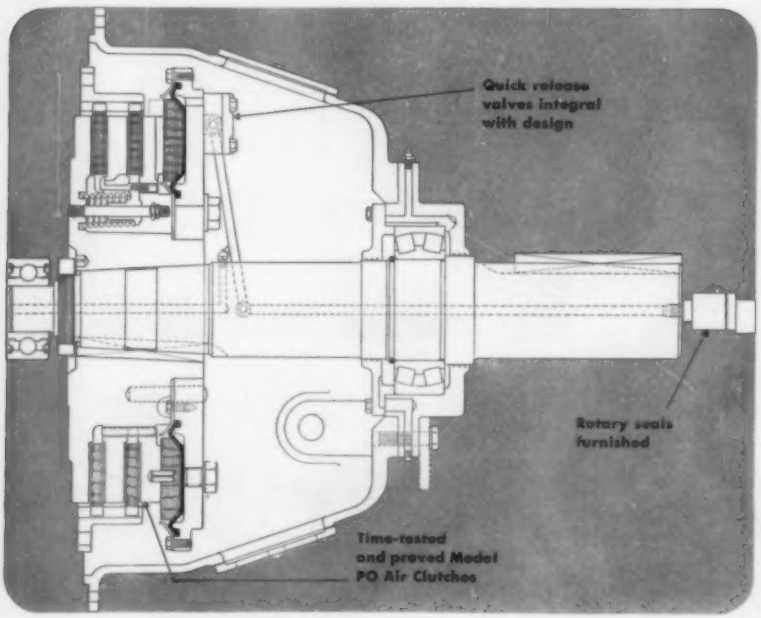
Easy-to-install air-operated conversion kits are available for certain standard models of Twin Disc PTO's already in the field.

Twin Disc Clutch Company, Racine, Wisconsin; Hydraulic Division, Rockford, Illinois.

TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES

TWIN DISC

Friction Clutches and Fluid Drives



magnitude and complexity of the undertaking, the speed with which it had to be done, and the differing interests involved. The wonder is that there was not more confusion and discord in carrying through so gigantic an operation. Compared with the achievement of meeting Europe's oil needs without shortages in the U.S. or compulsion by Government, any shortcomings in the program would seem minor.

"The alternative to industry handling the task on a voluntary basis would have been a vast government program. Former Mobilization Director Flemming told the senators in February that this would take at least 6 months to set up and would require 'bringing in a huge bureaucracy' to deal with a short-term problem.

" . . . The great lesson of the oil lift is its demonstration of what industry and government, working together, can accomplish."

First National City Bank of New York, monthly letter on business and economic conditions.

CALENDAR

JUNE

3-5	Petroleum Electric Power Association, annual convention, Amarillo, Tex.
3-7	Oil-Heat Institute of America, thirty-fifth annual convention, Sheraton-Plaza Hotel, Boston.
4-6	Second annual Appalachian Underground Corrosion Short Course, West Virginia University, Morgantown, W. Va.
6	Pennsylvania Grade Crude Oil Association, thirty-fourth annual meeting, Penn-Sheraton Hotel, Pittsburgh.
9-14	American Society of Mechanical Engineers, semiannual meeting, Sheraton-Palace Hotel, San Francisco.
10-12	Interstate Oil Compact Commission, midyear meeting, Yellowstone National Park.
10-14	Gordon Research Conferences, petroleum, Colby Junior College, New London, N. H.
12-14	Engineering Institute of Canada, annual meeting, Banff, Alta.
16-21	American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
17-21	Gordon Research Conferences, catalysis, Colby Junior College, New London, N. H.
18-19	Rocky Mountain Oil and Gas Association, annual meeting of refining committee, Northern Hotel, Billings, Mont.
19-21	Association for Computing Machinery, twelfth annual meeting, University of Houston, Houston.
20-21	Western Petroleum Refiners Association, Mid-Continent regional technical-industrial relations meeting, Broadview Hotel, Wichita.
20-22	National Oil Scouts and Landmen's Association, annual meeting, Hotel Cosmopolitan, Denver.
23-27	Canadian Gas Association, Jasper Park Lodge, Jasper, Alta.

JULY

8-19	Industrial Statistics for the Process

So dependable it's the world's first choice!

Call him "Señor" or "Mister"—no matter where you go, you'll find oilmen trust the dependability of TOTCO. TOTCO double recorders are built to take the highest well pressures and the hottest bottom temperatures. And TOTCO's skillfully trained servicemen trouble-shoot the globe to make sure that TOTCO double recorders help get the *accurate* drilling job you need. That's why most oilmen the world over say, "Be sure you know, use TOTCO!"

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There's no puzzle to meeting the exacting demands of rough, off-the-road construction work when you depend on Leland's famous "Packaged Unit" for dependable service — trouble-free operation.

Headache Rack — for absolute safety to operator. Heavy duty hydraulic tubing frame, mounts spare wheel.

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Gin Pole Pocket Settings — for double or single gin-pole use, bearing housings for rolling tailpipe, recessed in one-piece steel castings with gin poles.

Rolling Tail Pipe — seamless hydraulic tubing, mounted on shielded ball bearings, in special castings.

Flush Mounted Body Deck Plate — 2" hardwood flush mounted with steel — recessed snatchblock toggle, pole trailer bolster hole in tailboard.

Before you equip for your next job, you owe it to your pocketbook to see a Leland representative.

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EQUIPMENT COMPANY
Oklahoma City • TULSA • Longview, Texas

Industries, second annual conference, sponsored by American Society for Quality Control and the University of Oklahoma, Lockett Hotel, Norman, Okla.

AUGUST

26-28 Seventeenth annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

28-30 Instrument Society of America, International Symposium on gas chromatography, Kellogg Center, Michigan State University, East Lansing, Mich.

SEPTEMBER

3-5 Pacific Coast Gas Association convention, Fairmont and Mark Hopkins Hotels, San Francisco.

5-7 New Mexico Geological Society, eighth annual field conference, southwestern Colorado.

8-13 American Chemical Society, 132nd national meeting, New York City.

9-10 Independent Natural Gas Association of America, annual meeting, Shamrock Hilton Hotel, Houston.

11-13 National Petroleum Association, fifty-fifth annual meeting, Traymore Hotel, Atlantic City, N. J.

19-21 Rocky Mountain Oil Show, fairgrounds, Casper, Wyo.

23-25 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Mayo Hotel, Tulsa.

26-27 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

26-27 Mid-Continent Oil and Gas Association, Louisiana - Arkansas division, Roosevelt Hotel, New Orleans.

30-Oct. 2 American Oil Chemists' Society, 1957 fall meeting, Netherland Plaza Hotel, Cincinnati.

OCTOBER

1-2 Texas Mid-Continent Oil and Gas Association, thirty-eighth annual meeting, Texas Hotel, Fort Worth.

2-4 Golden Trend Oil Show, Pauls Valley, Okla.

6-9 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fall meeting, Adolphus, Baker, and Statler Hilton Hotels, Dallas.

7-9 American Gas Association, annual convention, Kiel Auditorium, St. Louis.

7-11 American Institute of Electrical Engineers, fall general meeting, Morrison Hotel, Chicago.

13-15 American Association of Oilwell Drilling Contractors, seventeenth annual meeting, Mayo Hotel, Tulsa.

13-19 OIL PROGRESS WEEK.

17-18 American Institute of Mining, Metallurgical, and Petroleum Engineers, Southern California petroleum section, fall meeting, Biltmore Hotel, Los Angeles.

17-19 Four Corners Geological Society, second field conference, Gallup, N. M.

20-22 National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Peabody, Memphis.

24-25 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

27-29 Independent Petroleum Association of America, annual membership meeting, Statler Hilton Hotel, Dallas.

31-Nov. 1 American Association of Petroleum Geologists, Mid-Continent regional meeting, Cimarron Ballroom, Tulsa.

Turn This Page

to see the

Greatest Improvement

in Slush Pump

Valve Design

in 25 Years

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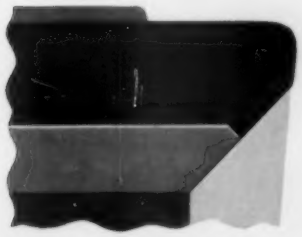

Conventional valves use a sealing element that seals at an angle, usually in the same plane with at least part of the striking surface. This arrangement works well when the valve is new and when pump pressures are low.

With wear, however, an opening forms at the junction of valve body, seat and sealing element. High pump pressures force part of the rubber sealing element into this space and it is pinched off. The result is short life for both sealing element and valve.

MISSION MUD MONARCH

NEW

With Mud Monarch Valves, the valve body strikes against the entire inclined surface of the valve seat, and the near-vertical seal ring seals against the outside diameter of the valve body. With this design, seal ring life is independent of valve and seat wear.

WORN

With wear, the entire inclined striking surface of the seat is worn away. An opening can't form next to the seal ring. Both valve and seat wear longer before they need be replaced and seal ring life is increased substantially—

HERE'S WHY MUD MONARCH VALVES LAST LONGER THAN CONVENTIONAL VALVES UNDER JET DRILLING CONDITIONS

Most slush pump valves do a good job when they are new, but when valve body and seat become worn, an opening forms between seat and body next to the sealing element that plays havoc with valve life. This condition exists, to a certain degree, with all valves except the Mud Monarch. By preventing the formation of this opening, Mission Engineers have developed a valve that gives truly outstanding service — especially in high pressure jet drilling where most valves fail rapidly. If you are dissatisfied with the service you are getting from slush pump valves, try the Mission Mud Monarch. You will discover a new high in valve performance and a new low in valve costs. Like all Mission Products, Mud Monarch valves are guaranteed to give outstanding service or your money is refunded. You can't lose, so try them right away. They are made in sizes to fit most pumps and are available through all supply stores.

Mission Mud Monarch Valve

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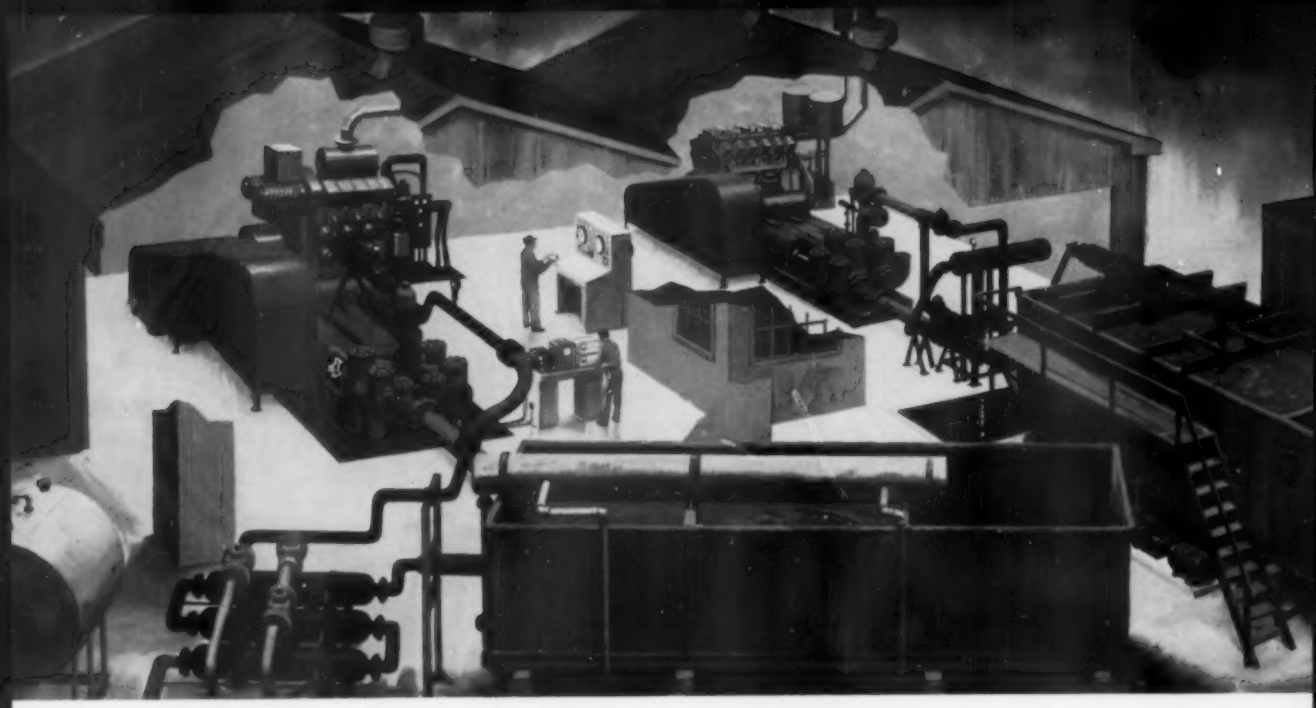

Only Mission has a fully instrumented test pump "laboratory" like this...

No other pump parts manufacturer has such an advanced setup. These test pumps at the Mission main plant are fitted with the latest in electronic test instruments including a fourteen channel recording oscillograph. This instrument is, to the Mission Research Engineer, what an electrocardiograph is to a doctor! Here, Mission research men conduct tests using a variety of contaminated or sand laden muds at temperatures that average 155°F and pressures that often exceed 2,000 psi. Without these test pump facilities, it would have been impossible to have developed the Mud Monarch Valve whose superiority has been proved in hundreds of field installations.

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the OIL AND GAS JOURNAL

TULSA, OKLAHOMA

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JOURNALLY SPEAKING

For the Birds

OUR UNIMAGINATIVE engineering editors, who consistently rule out human-interest stuff in preference for technical details, omitted this picture from the special section on Tidewater's new refinery, which takes up a big hunk of this week's book.

It shows an unplanned feature of what is otherwise probably the best-planned refinery in the world—a free-lunch counter for the birds.

It seems that this refinery pumps up huge gobs of water from the Delaware River, fish and all. A screen filters out the marine life and every so often it automatically flushes itself and dumps the fish, alive and kicking, down this concrete trough toward the river again.

But it didn't take the local sea gulls long to find out about this bonanza. Every time they hear the machinery start to dump the screen they recognize it as the dinner bell and flock around the fresh-seafood bar. The lazy freeloaders have given up fishing for a living. They have become permanent guests of Tidewater, and just hang around and wait for the next handout. For the birds, it's a reenactment of the biblical miracle of the loaves and fishes.

But for crude producers in the Mid-Continent, this Tidewater refinery is no miracle but is like some of the less pleasant Bible stories, say Armageddon. They think it's for the birds, all right, but there won't be any free lunch in it for them.

Not that producers begrudge anybody having a fine, new refinery. It's the location that worries them—just as close to the Middle East oil fields as it's possible to get and stay in this country.

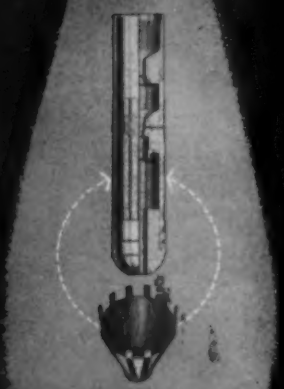
Some of the old-timers recall that Tidewater got its name because it built the first pipeline from the Pennsylvania fields to the East Coast to give independent producers access to world markets. If the trend continues toward building all the new refineries to run on Middle East crude, some of the independents feel that the only way they will continue to eat is to join the sea gulls along the Delaware.

Incidentally, we are reminded that when Tidewater built that first pipeline to the coast it had quite a fight with the teamsters. They thought a pipeline was for the birds, and kept trying to tear it up. That was before the teamsters had Dave Beck, but they seemed to do pretty well for themselves without a union in those days.

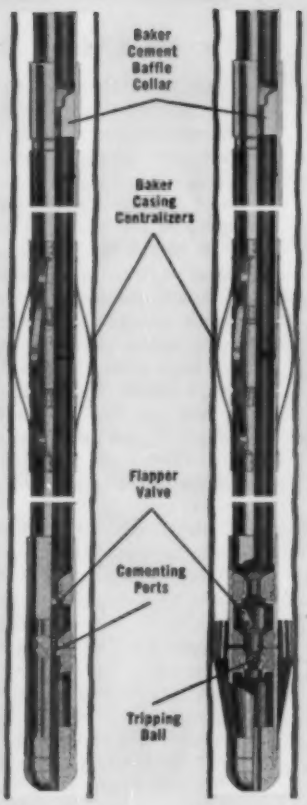
Today the U. S. Senate seems to be trying to tear up the teamsters, and it thinks the Fifth Amendment is for the birds—jailbirds.

—Henry D. Ralph.

Protect permeable low pressure zones with the BAKER TRIPLEX cementing shoe...



The overlapping Petals form a strong, tight bridge to prevent downward movement of slurry.



Cementing casing at a predetermined point above bottom, and at the same time protecting a lower, permeable zone from cement contamination always has been a difficult problem. Such work is now a routine operation with a Baker TRIPLEX Cementing Shoe.

A special float shoe is combined with a Baker Metal Petal Basket that expands to form a bridge and retain cement slurry **above** the Basket, even in large-diameter or irregularly shaped holes. The TRIPLEX Shoe, with its flapper-type back-pressure valve, operates as a conventional **float** shoe while landing the casing and conditioning the hole. When cementing is done and pump pressure is stopped, the valve closes and cement is **held in place behind the casing until it sets.**

Baker Casing Centralizers are installed on (and above) the shoe joint, thus providing a uniform annulus to receive the slurry. While running-in, a Hold-Down Strap (secured by shear screws) retains the Basket against the TRIPLEX Shoe, and the cementing ports are covered by the Tripping Valve. After reaching the desired point, a Tripping Ball is dropped to seat upon the Tripping Valve. Pressure is applied to shear the screws, force the Tripping Valve downward, and expose the cementing ports. This action releases the Hold-Down Strap and the Basket expands against the walls of the hole. When cementing starts, the slurry is directed upward by Baker "Whirling" Action, and retained **above** the shoe by the Metal Petal Basket.

BAKER OIL TOOLS, INC., HOUSTON • LOS ANGELES • NEW YORK

Control gas prices but don't wreck the system

TESTIMONY on the Harris-O'Hara bill to date demonstrates that some eastern consumer and regulatory interests still have no understanding of how natural gas is found, produced, and marketed.

They seem to picture producers and producing states as a conspiracy to gouge consumers. They feel that they now have the conspirators in their net and will not release them unless hobbled, leashed, and muzzled.

They persist in the belief that the issue is control of producers as such, whereas the real problem is to devise a system that will develop new reserves at prices commensurate with present and future conditions of development costs and of market demand.

THE TWO administration amendments reflect this view. The storm of protest they have aroused from both producers and informed distributors shows that they are at variance with the bill's philosophy.

And the fact that the administration sponsors of these proposals are having difficulty explaining them and are uncertain how they would operate, strongly suggests that they were hastily conceived and not thoroughly thought through.

Even as introduced, the bill contains some serious and perhaps fatal concessions to those who seek federal regulation of actual producing operations. Undoubtedly the bill had to be a compromise, but on some points principle may have been compromised too far.

Perhaps the most potentially dangerous provision is that limiting state action. It is one thing to agree that states may not impose minimum prices on gas going into interstate commerce. But it is quite another to do this in language that might wipe out all state production taxes, conservation measures, and intrastate regulation.

Producers and the governments of producing states are rightly alarmed over this provision. In view of the trend of Supreme Court rulings extending federal authority, the present language could well lead to elimination of all state powers over oil and gas production.

This is too high a price to pay for peace in the gas industry.

PRODUCERS SHOULD SUPPORT a compromise bill which contains some price control if the method is sufficiently realistic and flexible to let field prices gravitate toward their economic levels. This the Harris-O'Hara bill does in most of its provisions.

But they should not compromise on federal regulation of actual production. Nor should they accept the administration amendments if, as now appears, they would operate to destroy the workability of the system and the very philosophy of the draft so painfully negotiated by the industry during the past year.

Gardner-Denver Builds

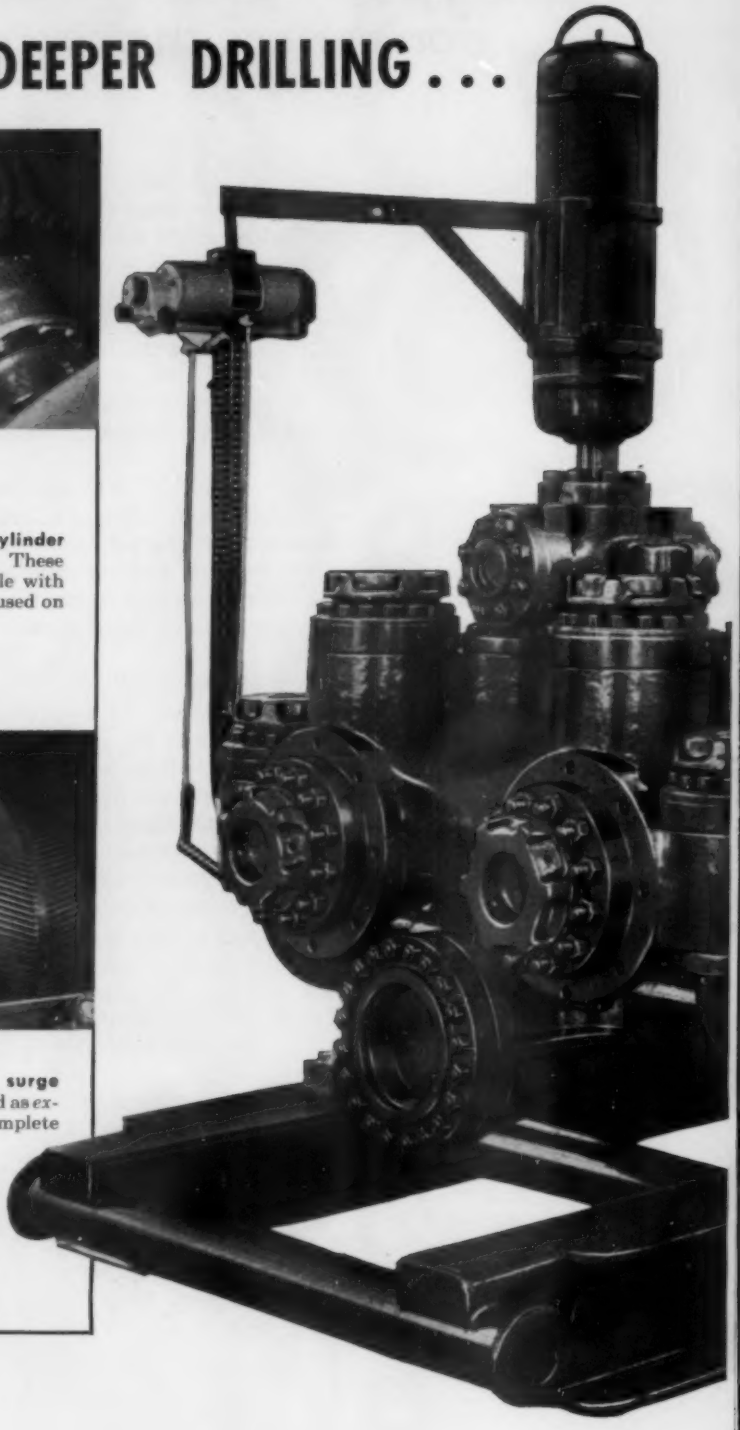
TO SPEED DEEPER DRILLING . . .

Dual, gear-driven oil pumps. Assure full lubrication at all times. Driven directly from the helical gears.

Threaded fluid cylinder locks and rings. These are interchangeable with valve cover locks used on valve pots.

Counterbalanced eccentric. This exclusive GH-GXH feature helps reduce unbalanced forces usually transmitted to the pump foundation or mounting platform.

Newly designed surge chamber. Furnished as *extra equipment*, complete with boom, Keller half-ton hoist, trolley, filter and lubricator, and 8′ air hose. Simplifies handling of heads, valve locks, liners, etc.



Giant 1250 h.p. Mud Pump

TO PROTECT YOUR HUGE WELL INVESTMENTS

This pump is now being manufactured in regular production. Confer with your Gardner-Denver oil field specialist in Dallas, Houston, Corpus Christi, Odessa, Wichita Falls, New Orleans, Shreveport, Oklahoma City, Ellinwood, Casper, Edmonton, Tulsa, Pittsburgh or Los Angeles. Or write Gardner-Denver Company about your mud pumping problems, and for details of the Gardner-Denver GH-GXH 1250 h.p. mud pump.

Gardner-Denver 1250 h.p. mud pump GH-GXH. Liner sizes, 7¾" to 6". Stroke, 18". Deliver from 884 gpm at 2060 psi, using 7¾" liners, to 500 gpm at 3642 psi, with 6" liners.

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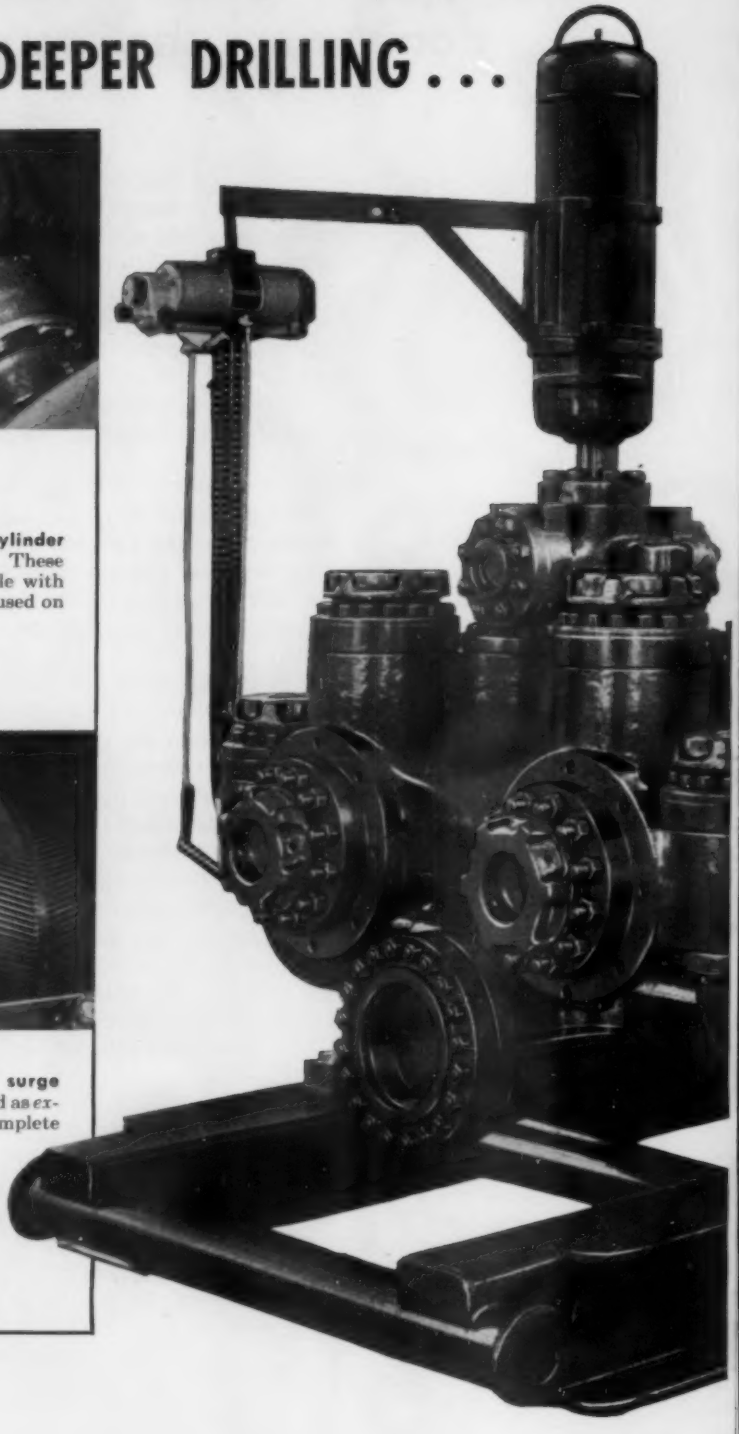

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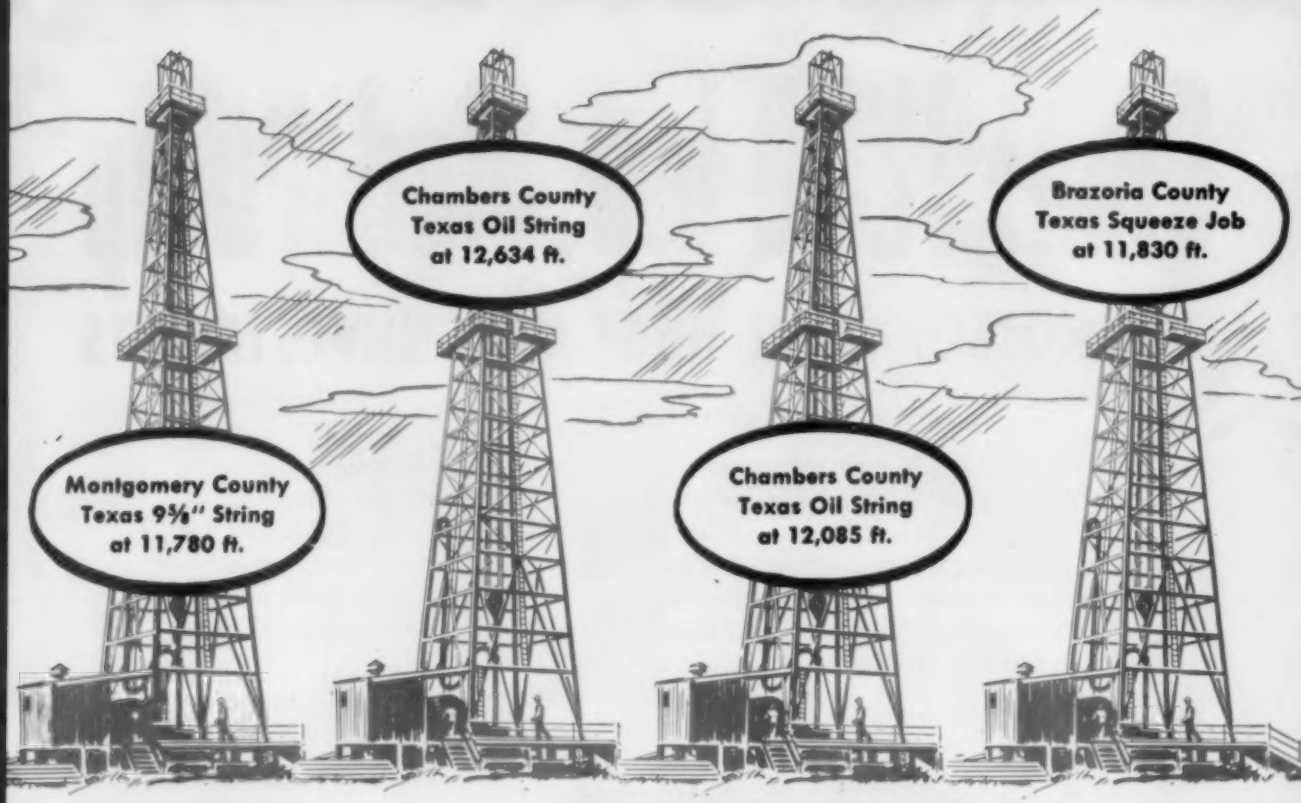


AS TEXAS GULF COAST WELLS GET DEEPER AND HOTTER

'Starcor' Gives Outstanding Performance

...NOW, AS IN 1936

Select Cement to Fit the Job!

● Back in 1936, few wells were drilled below 7500-8000 ft. In some fields, temperatures ranged from 185 to 200°F, with high pressures. Pumping equipment was a long way from what it is today. Operators were often hard pressed to get a good cementing job with "common" cement.

A slow-setting cement was needed—'STARCOR' SLOW-SETTING OIL WELL CEMENT met that need, met it well, as shown by the fact that wells cemented with 'Starcor' a generation ago are still producing, the original cementing jobs holding tight.

Equally outstanding is today's 'Starcor' performance at the greater depths made possible by improved equipment and methods. In the deep, hot Texas Gulf Coast wells, for example (typical jobs, listed above), 'Starcor' is performing perfectly, adding a new chapter to a distinguished service record.

Lone Star offers you four great cements: LONE STAR Cement, standard of highest quality for half a century...'INCOR'*, America's FIRST High-Early, Sulphate-Resistant Cement...'STARCOR'* Slow-Setting Oil Well Cement...'TEXCOR'* Deep Oil Well Cement. Select the one that fits your job—the extra quality margin is important to you.

*Reg. U.S. Pat. Off.

LONE STAR CEMENT CORPORATION

Offices: DALLAS • HOUSTON • ABILENE, TEX.
LAKE CHARLES, LA. • NEW ORLEANS • BIRMINGHAM
KANSAS CITY, MO. • ALBANY, N. Y. • BETHLEHEM, PA.
BOSTON • CHICAGO • INDIANAPOLIS • NEW YORK
NORFOLK • RICHMOND • SEATTLE • WASHINGTON D. C.

How Companies Are Scheduling Imports Through September

(Thousands of barrels daily)

	April		May		June		July		August		September	
	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957	1956	1957
CRUDE—EAST COAST:*												
Atlantic Refining Co.	56.7	54.7	64.0	69.4	70.5	69.4	70.2	69.4	79.0	69.4	80.2	69.4
Cities Service Co.	20.1	15.8	33.5	25.9	21.3	11.2	36.3	§13.7	44.8	§10.5	14.9	§10.7
Eastern States Petroleum Co.	7.3	5.3	32.1	12.0	14.9	12.0	17.0	10.0	41.9	10.0	8.4	22.0
Gabriel Oil Co.	6.5	3.7	5.4	7.1*	8.5	7.3	6.3	7.1	3.5	7.1	6.5	7.3
Gulf Oil Corp.	101.0	89.0	126.0	112.0	167.0	153.0	149.0	153.0	127.0	153.0	138.0	153.0
Hancock Oil Co.	(‡)	(‡)	1.8	(‡)	(‡)	(‡)	1.7	(‡)	(‡)	(‡)	(‡)	(‡)
Lake Superior Refining Co.	5.3	4.7	5.3	5.2	5.3	5.3	5.5	5.2	4.0	5.2	4.2	5.3
McBride Oil & Gas Corp.	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)
Phillips Petroleum Co.	6.5	13.3	14.2	11.7	6.3	12.1	9.8	11.7	11.9	11.7	13.0	12.1
San Jacinto Petroleum Corp.	1.6	....	1.7	....	....	....	1.6	....	....	....	4.1	....
Signal Oil & Gas Co.	....	....	1.7	....	....	....	1.6	....	....	....	1.8	....
Sinclair Oil Corp.	68.4	70.4	69.1	72.5	83.3	79.4	86.4	77.6	67.0	78.6	76.5	70.7
Shell Oil Co.	0.5	....	1.0	....	1.0	....	1.0	....	0.5	....	....	....
Socony Mobil Oil Co., Inc.	64.4	51.7	74.1	62.0	66.8	61.9	69.2	78.2	68.3	78.2	61.8	78.2
Sohio Petroleum Co.	1.6	....	1.7	....	....	....	1.2	7.5	3.9	7.5	4.3	7.5
Southwestern Oil & Ref. Co.	3.6	....	....	3.6	3.7	3.8	....	3.6	3.7	....	3.8	....
Standard Oil Co. of California	91.9	58.6	82.0	85.1	84.2	85.1	85.1	85.1	74.5	85.1	76.9	85.1
Standard Oil Co. (Ind.)	16.8	49.3	17.1	45.9	21.0	56.7	17.5	53.8	20.5	53.3	27.7	53.3
Standard Oil Co. (N. J.)†	72.0	79.0	74.0	89.0	90.0	89.0	89.0	89.0	72.0	89.0	91.0	89.0
Sun Oil Co.	34.4	7.5	30.1	14.3	64.5	19.0	55.7	7.3	42.5	11.3	67.7	7.5
The Texas Co.	52.4	38.8	64.3	72.3	80.7	75.8	88.3	85.5	72.9	79.2	62.9	65.0
Tidewater Oil Co.	15.1	75.7	14.5	96.4	23.1	90.7	26.0	79.8	27.4	89.0	35.1	75.0
Total East Coast	626.1	617.5	713.6	784.4	812.1	831.7	818.4	837.5	765.3	838.1	778.8	811.1
CRUDE—WEST COAST:*												
Douglass Oil Co. of California	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	(‡)	8.1	(‡)	(‡)	(‡)
Shell Oil Co.	4.0	47.2	....	41.0	....	37.4	3.9	56.5	47.2	45.1	49.5	46.7
Signal Oil & Gas Co.	1.6	....	....	....	....	....	....	....	....	....	....	....
Socony Mobil Oil Co.	27.6	30.2	47.6	29.5	34.6	26.5	27.7	26.5	29.9	26.5	39.8	26.5
Standard Oil Co. of California	19.5	25.5	17.1	59.0	16.0	59.0	27.3	59.0	27.4	59.0	35.0	59.0
The Texas Co.	30.7	12.7	46.3	13.6	15.4	19.3	45.9	20.0	17.4	26.5	22.6	27.2
Tidewater Oil Co.	32.3	42.7	39.2	54.0	58.1	61.5	47.3	66.8	48.0	55.6	42.8	56.4
Union Oil Co. of California	14.1	34.3	13.3	22.0	6.9	22.0	14.7	22.0	6.5	22.0	10.0	22.0
Wilshire Oil Co.	5.3	31.3	19.8	24.0	18.1	24.0	24.0	24.0	22.6	24.0	16.6	24.0
Total West Coast	135.1	223.9	183.3	243.1	149.1	249.7	190.8	274.8	207.1	258.7	216.3	261.8
Total crude	761.2	841.4	896.9	1,027.5	961.2	1,081.4	1,009.2	1,112.3	972.4	1,096.8	995.1	1,072.9

*From company reports to the Texas Railroad Commission. †Based on quarterly estimates. ‡No forecast received by commission. §Unable to forecast crude from Middle East.

Crude-Oil Imports Head for New Highs

THE domestic oil industry faced up to two tough facts last week:

...**Foreign oil imports** will pass the 1,000,000-bbl. daily mark this month and maintain that rate through the third quarter.

...**Any relief** from the increase in oil imports likely won't come from Washington before late summer.

Latest measurement on how imports are rising came from statistics released by the Texas Railroad Commission. Importing companies which do business in Texas reported they brought in 841,400 bbl. daily of foreign crude oil in April. This was an increase of 80,200 bbl. daily over the same month in 1956 (see table above).

But the importing tide will step up to 1,027,500 bbl. daily in May and stay there for the next 4 months. The May shipments will be 130,600 bbl. daily more than

these companies brought into the U.S. during May 1956.

Average imports for the third quarter of this year will be 1,094,000 bbl. daily compared with a 1956 average of 992,230 bbl. This represents a third-quarter increase this year of 101,970 bbl. daily.

The Office of Defense Mobilization reported that importers actually plan a heavier schedule for the third quarter than Railroad Commission statistics indicate. Additional companies which don't operate in Texas reported to the ODM. The government agency reported third-quarter imports will average 1,250,000 bbl. daily. That's even 156,000 bbl. daily more than reported to the Railroad Commission (table at right).

The difference between the two sets of statistics was in estimates on receipts from the Middle East and Canada. Commission figures for crude from the Middle East were 61,000 bbl. daily below ODM totals. Commission estimates for Canada were under ODM averages by 53,000 bbl. daily in the Great Lakes area and 23,000 bbl. daily on the West Coast.

No hurry . . . But both sets of figures show one thing: Imports are hitting a high plateau and show no signs of receding.

There was no hint in Washington that any immediate action will be taken to deal with the problem. Mobilization Director Gordon Gray is leisurely talking to importing-company officials. He's asking their views on cutting imports voluntarily.

President Eisenhower has not yet even named the special committee to study the problem. He announced such a move would be taken when Gray reported in April he "had reason to believe" that crude imports threaten the national security.

Gray, himself, is making slow headway on his effort to work out voluntary limits on imports, company by company. So far he has talked with a half-dozen companies. He has many times that number still to talk with.

All signs in Washington point to a long, drawnout approach to the problem. It's doubtful whether any definite action will be announced either by Eisenhower or Gray before Congress adjourns in early August. This fact also is becoming more apparent: Any action taken by the President likely will be along the lines of voluntary effort rather than tough restrictions.

The Government's course on imports, in other words, appears to hinge on the willingness of importing companies to curb themselves. If they can work out a voluntary plan without involving antitrust restrictions, the President will be relieved of taking official action under the Trade Agreements Act.

Third Quarter Crude Imports

(Thousands of barrels daily)

	Reported to: Texas R.R. Comm.	ODM	Difference
Dist. 1-4—			
Canada	5	58	—53
Venezuela	543	539	4
Other W. Hem.	40	40	
Middle East	241	307	—66
Far East			
Total Dist. 1-4	829	944	—115
Dist. 5—			
Canada	118	141	—23
Venezuela	16	27	—11
Other W. Hem.			
Middle East	65	60	5
Far East	66	78	—12
Total Dist. 5	265	306	—41
Total U. S.	1,094	1,250	—156

Tariff or quotas? . . . Industry spokesmen, however, continue to discuss the merits of control plans. Will it be a tariff or quota on imports?

Members of Texas Independent Producers and Royalty Owners Association, meeting last week in Galveston, supported the tariff idea. A resolution was voted asking for a tariff or excise tax on imported crude immediately if possible but no later than the next session of Congress.

A preamble to the resolution suggested a tax of 40 per cent of value to protect the domestic industry. It also suggested that any new tariff be applied only to imports exceeding the 1954 ratio of imports to domestic production.

Majority of TIPRO members favored avoiding quota restrictions. They thought these might lead to federal control of domestic production. The Texans also expressed lack of confidence that any relief will come from administrative action. They instructed their officers to use every possible provision of existing laws to put some curb on imports.

A tariff plan with a new wrinkle was presented in Cleveland by J. C. Donnell II, president of Ohio Oil Co. He proposed a tariff on imported oil on a sliding scale rising with distance from the United States. This would encourage oil development and production in foreign lands relatively accessible and which could contribute to the national defense in case of emergency, he said.

A volunteer . . . The voluntary-control plan got a boost from one source last week.

B. Brewster Jennings, chairman of Socony Mobil Oil Co., said "we believe that voluntary cooperation by the importing companies has worked better than its critics admit."

He also declared: "Those who oppose imports are inclined to quote figures applying to the whole of the U. S., disregarding the fact that our Pacific Coast area cannot produce enough oil for its needs.

"Furthermore, Canada, from which some oil is imported, is a logical source for U. S. areas both west and east of the Rockies. Canada is so closely tied to our economy that one inclines to regard it as an integral part of our U. S. oil supply picture. Venezuela and the other Latin American nations are only slightly less so."

Ike Sidesteps Depletion Fight

WASHINGTON.—President Eisenhower refused last week to get involved in recent congressional attacks on the oil industry's depletion allowance.

There is no doubt that some rich men have taken advantage of the 27½ per cent credit allowed against income tax for oil and gas production, Eisenhower said. But he is not prepared to say the allowance is evil, he told a news conference. The allowance has served as an incentive for necessary oil production, he said.

The President's remarks indicated that the Treasury Department position is in line with his thinking. Sec. George Humphrey has called the depletion allowance a good thing because it has brought out needed oil. He has never expressed a view, however, as to whether the 27½ per cent figure is proper, too high, or too low.

Reduction of the allowance has been the aim of a number of bills offered in Congress this year. In one bill, four senators called for a cut to 15 per cent. Seven bills have been put in the House. Most of them call for a 15 per cent rate. But one, written by Rep. Henry S. Reuss of Wisconsin, proposed last week to limit it to 5 per cent.

The depletion allowance is expected to become an issue in the discussion of tax reductions next year. Eisenhower said at his conference that he is opposed to any tax cut until the budget is in sound condition. But congressional leaders have indicated an intention to cut taxes next year, nonetheless.

ATLANTIC TEAM of Sooy, left, and Adair show how . . .

Recruiting Gets a New Look

Atlantic Refining hits manpower jackpot by sending out key men to hire engineers for Venezuelan staff

OIL companies plagued with the problem of quickly expanding their technical staffs in Venezuela might take a tip from Atlantic Refining Co.

Atlantic, like many other companies who have just won new exploration concessions in Venezuela, needs more engineers and top supervisors. The company plans to expand operations on its present holdings as well as begin drilling in new areas.

So two representatives of the company made a quick sweep last week through Texas and Oklahoma to sign up engineers and technicians. They used a new approach in recruiting for foreign service. The result: The quota of men needed was oversubscribed.

The recruiters also reported an additional bonus. Interest was so high they had a chance to choose from among the applicants. The men picked were the ones officials felt best fitted the program of the company's subsidiary, Venezuelan Atlantic Refining Co.

The approach . . . Atlantic's first move was to send top-drawer men on the recruiting staff.

The team consisted of Lewell Adair, manager of Atlantic's field operations in Venezuela and a veteran of oil work in that country, and W. A. Sooy, foreign personnel supervisor from the Philadelphia home office.

This gave prospective applicants the chance to meet Adair and talk with their top field boss in Venezuela. They got a full run-down on what kind of work they would be doing, what life in Venezuela is like, and a chance to size up the company. Sooy also was able to explain company personnel policies, to accept applications, and quickly begin processing them.

The Adair-Sooy team was given authority to talk salaries with prospects who showed keen interest. In addition they could make a firm offer of a job on the spot without going through a long chain of commands back to the home office.

Atlantic had set up a quota of 20 men needed at once for Venezuela. These included petroleum engineers, drilling engineers, geologist, paleontologist, reservoir engineer, production foremen and rig mechanics. Adair and Sooy filled the quota before their tour was completed. But they made job offers to more men than originally intended. The company decided the caliber of the men was so good they all eventually would be needed anyway in Atlantic expansion plans in Venezuela.

Interest high . . . Adair and Sooy reported interest in foreign work was high among oil people.

The team visited Houston, Midland, and Dallas, and Tulsa. At Midland they talked with a near-record group. Some of the visitors frankly said they didn't want to apply but just wanted to hear about the opportunities of foreign work.

One such man was a Texas glass-cutter. He said he was sure no glass-cutters were needed by Atlantic, but he wanted to know what Venezuela offered in his line.

Atlantic's deal for work abroad is in line with those of other majors. The pay is good—but not fantastic. Young engineers, for instance, in the lower-pay brackets can do much better on the foreign salaries. More experienced men in top brackets earn only slightly more in base pay. But the tax advantages and cost-of-living bonuses allowed still make the pay very attractive.

The treatment . . . The first engineers signed up by Atlantic on the recruiting tour will begin flying abroad within a month or so.

They weren't signed to a contract for a stated number of years. They were offered a career with Atlantic with the opportunity of being transferred to domestic jobs with the company after their tour of foreign duty. The offers were made subject to the men passing a physical examination and a check on their references.

After reaching Caracas, they will be given a month's schooling. They'll speak nothing but Spanish at the boarding-house school. There they will also learn the customs, history, and culture of the country. After that, they'll either be assigned to the home office in Caracas or to a base camp.

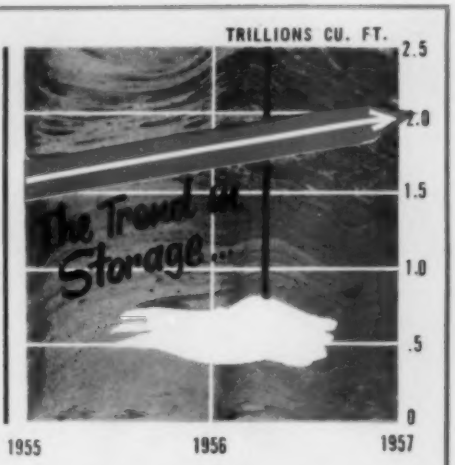
Atlantic holdings . . . Atlantic has been operating in Venezuela for many years.

Before this year's new concessions, Atlantic had 650,000 net acres in Venezuela and 15,000 bbl. daily production. In the bidding this year, the company applied for 126,000 acres more, either on a full-interest basis or jointly with other oil companies.

Atlantic plans to start drilling operations by December on Block 11 in Barinas. It is operator for the 10,000-acre tract held jointly with Sun Oil Co. and Pan Venezuelan Oil Co. Well depths of 10,000-11,000 ft. are expected. Atlantic will drill later on its new Block 27 Barinas holdings and on acreage it acquired in the Gulf of Paria. Sun will be operator on a concession in Lake Maracaibo in which Atlantic holds ⅓ interest.

Here's how the gas industry is growing:

- PIPELINES are opening new markets. Last year 10,000 miles of transmission lines were laid.
- NEW customers added last year totaled 2 million.
- DEMAND, as a result, climbed 9.3 per cent.
- THE SPREAD between production and peak-day demand continues to increase.



Gas Storage: Big Business, Big Future

Robert B. Bizal
District Editor

UNDERGROUND storage, a revolutionary concept in the gas industry just 10 years ago, today is a healthy giant — and one that's still growing.

With completion of projects now under way, storage capacity will pass 2 trillion cubic feet—more than the total reserves of West Virginia, for example, which ranks tenth among the nation's gas-producing states.

In fact, if all of today's storage reservoirs were filled, they would hold enough gas to supply the entire United States for 72 average-weather days.

The end to this growth isn't yet in sight. Distributors are constantly on the prowl for the right kind of underground formations at the right places. The reason is simple:

The industry is adding new customers every year. Last year it added 2,000,000. As demand grows, so does the spread between daily production and the peak demand of winter's coldest days. The solution is to move the gas when demand is low in summer, store it near consuming centers, and withdraw it to meet the heavy-demand days of winter.

The picture today . . . The Oil and Gas Journal's annual survey shows that at least 50 companies will be able to store as much as 2,010,233,966 M.c.f. with present and planned facilities.

Last year's survey showed a capacity of 1,796,464,943 M.c.f.

This continuous expansion means a much-needed ace in the hole for peak-day performance in winter months—especially in the heavily populated eastern and northeastern United States. That's where well over half the storage is concentrated.

It also means lower operating costs for some pipeliners. More than ever before, they are better able to stabilize year-round load factors by transporting winter gas during slack summer months.

Hand in hand with this big expansion are these healthy natural-gas trends:

. . . Reserves are at an all-time high. Operators found more reserves in 1956 than in any other single year.

. . . Demand is climbing. It jumped 9.3 per cent in 1956.

. . . Successful gas wildcats are on the increase. Last year's drilling program indicates 1957 may be another record gas-well drilling year.

. . . Another 10,000 miles of transmission lines were built in 1956, reaching heretofore untouched gas markets. Another record year is predicted for 1957.

New storage projects . . . How and where is underground storage contributing to this picture? At least a dozen big companies will make more room for winter use of summer-produced gas:

. . . New York State Natural Gas Co., which has interest in eight giant pools in Pennsylvania and New York, plans to add a ninth. N.Y.S.N.G. is part of the Consolidated Natural Gas Co. system, which operates five distributing companies in the East.

The new project, approved this month by the Federal Power Commission, is near Woodhull in Steuben County, New York. It will have a capacity of 35,200,000 M.c.f. and will be developed over a 3-year period at a cost of $11,610,000.

This includes $8,057,000 for development of a depleted gas field, and $3,553,000 for transmission lines to tie in with the market area. Plans call for drilling new wells and redrilling and reconditioning 59 old wells.

The 10,800-acre project is "designed to aid in solving the pressing problems of meeting increasing natural-gas demand requirements in northern Pennsylvania and New York."

. . . Iroquois Gas Corp. has another New York project in the making. It's at Nashville in Erie, Chautauqua, and Cattaraugus counties. Estimated capacity will be 8,000,000 M.c.f.

The company is expanding in other directions. It recently acquired Republic Light, Heat & Power Co. This included Republic's Arkwright and Sheridan reservoirs in Chautauqua County. Iroquois combined the two and calls it Sheridan. Capacity is 2,000,000 M.c.f.

. . . United Fuel Gas Co., one of the Charleston Group companies, is adding a big facility in West Virginia, where the company already has 18 storage pools.

The new one, in Kanawha County, is called X-52C and will hold 14,800,000 M.c.f. It will be ready for use this year.

. . . Lone Star Gas Co. began initial

(Continued on page 91)

Who Is Storing Gas Underground, Where, and How Much

Company (field or area—county)—	Capacity in M.c.f.
ARKANSAS	
Stephens Production Co.:	
Lavaca—Sebastian	3,832,786
Shibley—Crawford	1,123,258
Total	4,956,044
CALIFORNIA	
Pacific Gas & Electric Co.:	
Pleasant Creek—Yolo (planned)	3,250,000
Pacific Lighting Gas Supply Co.:	
East Whittier—Los Angeles	*1,500,000
La Goleta—Santa Barbara	14,400,000
Montebello—Los Angeles	12,500,000
San Diego Gas & Electric Co.:	
San Diego County	†18,487
Southern California Gas Co.:	
Playa del Rey—Los Angeles	*1,500,000
Total	33,168,487
ILLINOIS	
Mississippi River Fuel Corp.:	
Waterloo—Monroe (experimental)	500,000
Natural Gas Storage Co. of Illinois:	
Cooks Mills—Coles (planned)	2,000,000
Herscher—Kankakee	90,000,000
Northern Illinois Gas Co.:	
Various counties in northern Illinois	†184,700
Total	92,684,700
INDIANA	
Indiana Gas & Water Co.:	
Greensburg—Decatur	1,000,000
Unionville—Monroe	1,500,000
Texas Gas Transmission Corp.:	
Alford—Pike	2,469,300
Oaktown—Knox	1,038,100
Total	6,007,400
IOWA	
Northern Natural Gas Co.:	
Redfield—Dallas County (ultimate planned)	50,000,000
KANSAS	
Cities Service Gas Co.:	
Boyer—Butler	1,019,867
Colony—Anderson	9,203,665
Craig—Johnson	6,075,820
McLouth—Jefferson and Leavenworth	12,913,757
North Welda—Anderson	10,021,646
Piqua—Allen and Woodson	3,230,472
South Welda—Anderson	11,789,186
Consolidated Gas Utilities Corp.:	
Collinson—Cowley	1,100,000
Sutcliffe—Neosho	700,000
Union Gas System, Inc.:	
Buffalo—Wilson	
Elk City—Elk and Montgomery	
Fredonia—Wilson	8,620,000
Liberty North—Montgomery	
Liberty South—Montgomery	
Longton—Chautauqua	
Total	64,674,413
KENTUCKY	
Kentucky Gas Transmission Corp.:	
Manifee—Manifee and Powell	6,000,000
Louisville Gas & Electric Co.:	
Doe Run—Meade County, Kentucky, and Harrison County, Indiana	3,500,000
Muldraugh—Meade	1,900,000
Texas Gas Transmission Corp.:	
Dixie—Henderson	7,114,000
Hickory—Daviess	1,000,000
Grandview—Daviess	612,480
Western Kentucky Gas Co.:	
Kirkwood Springs—Hopkins	485,000
Owensboro—Daviess	56,000
Total	20,667,480
MARYLAND	
Washington Gas Light Co.:	
Montgomery County	‡70,000
MICHIGAN	
Michigan Consolidated Gas Co.:	
Austin—Mecosta	7,400,000
Coldwater—Isabella (planned)	Undetermined
Goodwell—Newaygo	14,500,000
Lincoln-Freeman—Mecosta	9,100,000
Reed City—Osceola	13,000,000
Six Lakes—Mecosta and Montcalm	53,000,000
Michigan Gas Storage Co.:	
Cranberry Lake—Clare	6,760,000
Riverside—Missaukee	2,060,000
Winterfield—Clare	16,660,000
Total	122,480,000
MISSISSIPPI	
Mississippi Valley Gas Co.:	
Amory—Monroe	1,045,656
United Gas Pipe Line Co.:	
Jackson—Rankin	1,200,000
Total	2,245,656
MISSOURI	
Laclede Gas Co.:	
Florissant—St. Louis	50,000,000
MONTANA	
Montana-Dakota Utilities Co.:	
Baker—Fallon	50,000,000
NEW MEXICO	
El Paso Natural Gas Co.:	
Rhodes—Lea	65,000,000
Southern Union Gas Co.:	
Barker Dakota—San Juan	19,884,135
Keyes—Eddy	1,805,183
Vandargriff—Eddy	3,110,682
Total	89,800,000
NEW YORK	
Home Gas Co.:	
Dundee—Schuyler, Steuben, and Yates counties	9,900,000
Gilbert—Allegany	575,000
Greenwood—Steuben	1,550,000
Iroquois Gas Corp.:	
Bennington—Wyoming	4,000,000
Collins—Erie	2,600,000
Derby—Erie	200,000
Holland—Erie	2,200,000
Lawtons—Erie	2,100,000
Nashville—Erie, Chautauqua, and Cattaraugus	8,000,000
Sheridan—Chautauqua	2,000,000
Zoar—Erie	2,000,000
New York State Natural Gas Corp.:	
Woodhull—Steuben (planned)	35,200,000
Sylvania Corp.:	
Tuscarora—Steuben	2,000,000
T.G.T.-Iroquois Gas Corp.:	
Colden—Erie	10,000,000
T.G.T.-New York State Natural Gas Corp.:	
State Line—Allegany County, New York (planned)	40,000,000
Total	122,325,000

OHIO

Company (field or area—county)—	Capacity in M.c.f.
East Ohio Gas Co.:	
Chippewa—Wayne	7,339,000
Columbiana—Columbiana	3,050,000
Stark-Summit—Stark and Summit	148,514,000
Manufacturers Light & Heat Co.:	
Brinker—Columbiana	6,800,000
Ohio Fuel Gas Co.:	
Benton—Hocking	37,700,000
Guernsey—Guernsey and Coshocton	5,000,000
Holmes—Holmes and Wayne	17,700,000
Knox—Knox	3,400,000
Lima—Mahoning	275,000
McArthur—Vinton	10,500,000
Pavonia—Ashland	32,000,000
Weaver—Ashland and Richland	70,000,000
Wellington—Lorain and Medina	18,800,000
Zane—Muskingum	80,000
Total	361,158,000

OKLAHOMA

Consolidated Gas Utilities Corp.:	
Ulan—Pittsburg	13,500,000
Oklahoma Natural Gas Co.:	
Depew—Creek	57,000,000
Haskell—Muskogee	10,900,000
Osage—Osage	2,730,000
Sayre—Beckham	89,300,000
Southwest Natural Gas Co.:	
North Ada—Pontotoc	10,000,000
Total	183,430,000

PENNSYLVANIA

Equitable Gas Co.:	
Bunola—Allegheny	5,186,044
Finleyville—Washington	486,043
Hunters Cave—Greene	3,062,080
Kirby—Greene	2,767,623
Pratt—Greene	4,374,405
Swarts—Greene	1,026,438
Tepe—Allegheny	1,596,058
Manufacturers Light & Heat Co.:	
Cross Creek—Washington	Being depleted
Donegal—Washington	6,800,000
Heard—Greene and Washington	8,600,000
Holbrook—Greene	890,000
Iowa—Jefferson	380,000
Irwin—Westmoreland	505,000
Majorsville—Greene and Washington counties, Pennsylvania, and Marshall County, West Virginia	30,000,000
McKinley—Elk	Being depleted
Munderf—Jefferson	90,000
Rush Run—Fayette	Being depleted
New York State Natural Gas Corp.:	
Sabinsville—Tioga	33,400,000
Sharon—Potter	5,900,000
South Bend—Armstrong and Indiana	17,100,000
Tioga—Tioga	22,400,000
N.Y.S.N.G. Corp.-Tennessee Gas Transmission Co.:	
Harrison—Potter County, Pennsylvania, and Steuben County, New York	32,800,000
Ellisburg—Potter (planned)	44,000,000
N.Y.S.N.G. Corp.-Texas Eastern Transmission Corp.:	
Oakford—Westmoreland	105,000,000
North Penn Gas Co.:	
Farmington—Tioga	10,000,000
Meeker—Tioga	5,000,000
Pennsylvania Gas Co.:	
Total for eight fields	8,736,628
Peoples Natural Gas Co.:	
Colvin—Washington	2,300,000
East McKeesport—Allegheny	Inactive
Gamble-Hayden—Allegheny	2,300,000
Haverline—Allegheny	150,000
Mount Royal—Allegheny	500,000
Murrysville—Allegheny	3,100,000
Patton—Westmoreland	150,000
Truittsburg—Clarion	3,700,000
Webster—Westmoreland	1,140,500
United Natural Gas Co.:	
Belmouth—Elk	400,000
Boone Mt.—Elk	900,000
Bullers—Jefferson	30,000
Galbraith—Jefferson	1,000,000
Henderson—Mercer-Venango	1,600,000
Markle—Jefferson	60,000
Mohan Run—Elk	70,000
Queen—Warren-Forest	150,000
St. Marys—Elk	140,000
Wellendorf—McKean	280,000
United Natural-Pennsylvania Gas Co.:	
Keelor—McKean	1,300,000
United Natural-Tennessee Gas Transmission Co.:	
Hebron-Potter	22,500,000
Total	391,870,819

TEXAS

Houston Pipe Line Co.:	
Bammel—Harris (option at cycling project)	2,000,000
Lone Star Gas Co.:	
Ambassador—Clay (planned)	2,500,000
Gause—Milam	75,000
Leeray—Stephens	7,080,000
New York City pool—Clay	6,223,000
Tri-Cities—Henderson	33,000,000
View—Taylor	3,500,000
Total	54,378,000

WEST VIRGINIA

Atlantic Seaboard Corp.:	
X-56—Upshur	7,000,000
Equitable Gas Co.:	
Comet—Taylor	4,425,475
Drain—Doddridge	326,769
Hayes—Marion	225,089
Logansport—Marion	3,081,232
Maple Lake—Taylor	1,834,353
Skin Creek—Lewis	1,226,449
Rhodes—Lewis (planned)	Undetermined
Godfrey L. Cabot, Inc.:	
Beaver—Raleigh	3,600
Heizer	2,000
Oak Hill—Fayette	33,000
Hope Natural Gas Co.:	
Bridgeport—Harrison and Taylor	9,500,000
Fink—Doddridge and Lewis	56,000,000
Kennedy—Harrison and Lewis	31,000,000
Newberne—Gilmer	5,000,000
Racket—Gilmer and Ritchie	4,000,000
Manufacturers Light & Heat Co.:	
Victory—Marshall and Wetzel	34,500,000
United Fuel Gas Co.:	
X-1—Putnam	3,600,000
X-2—Kanawha	4,850,000
X-4—Putnam	3,200,000
X-6—Kanawha	6,100,000
X-7—Kanawha	1,500,000
X-8—Kanawha	1,500,000
X-15A—Putnam	1,850,000
X-15B—Kanawha	2,250,000
X-17—Roane	2,750,000
X-19A—Roane	2,500,000
X-19B—Roane	2,200,000
X-49—Putnam	1,900,000
X-52A—Kanawha	35,000,000
X-52B—Kanawha	8,100,000
X-52C—Kanawha	14,800,000
X-53—Kanawha	60,000
X-54—Kanawha	4,500,000
X-58—Wood and Wirt	8,000,000
X-59—Jackson	20,000,000
Total	282,817,967

WYOMING

Montana-Dakota Utilities Co.:	
Billy Creek—Johnson	2,500,000
Elk Basin—Park County, Wyoming, and Carbon County, Montana	25,000,000
Total	27,500,000
Grand total	2,010,233,966

*Working storage. †Underground high-pressure pipe. ‡Steel container.

(Continued from page 88)

injection at Tri-Cities pool in Henderson County last November. By April, working capacity was up to 17,000,000 M.c.f., but officials say it will take another 2 years to complete injection to the ultimate 33,000,000 M.c.f.

It's the world's deepest storage pool, with injection in the Bacon and Rodessa limestone at 7,800 and 8,200 ft. respectively. It's also the highest-pressure underground storage project in the world. Lone Star plans to boost pressure ultimately to 3,200 psi., which is near the pool's original level *(The Oil and Gas Journal, December 17, 1956, page 102).*

Lone Star launched its over-all storage program in 1950. Now it has six storage facilities. The latest will supply the populous Dallas-Fort Worth area.

... **Ohio Fuel Gas Co.,** which has already invested more than $41,000,000 in nine storage pools in Ohio, is spending another $2,700,000 on a tenth one west of McArthur in Vinton County. Total capacity will be 10,500,000 M.c.f.

The project will involve drilling 90 new wells, conversion of 6 old gas wells, and construction of 15 miles of pipeline and a new compressor station.

The company will enlarge its storage pool in Holmes and Wayne counties to hold 17,700,000 M.c.f. of gas. Plans call for drilling 10 new wells and converting 51 old producers. Other projects include fracturing 60 existing wells and drilling 25 new ones, at a cost of $720,000.

Last winter more than 500,000 Ohio Fuel customers were house-heating with gas. During near-zero temperatures, storage gas provided about 55 per cent of the total gas used.

... **Equitable Gas Co.** has plans for another storage project at Rhodes field, Lewis County, West Virginia. Capacity has not yet been determined. The firm has 13 other reservoirs in West Virginia and Pennsylvania.

... **Michigan Consolidated Gas Co.** has purchased Coldwater Stray-Sand gas field in Isabella County, Michigan, and is developing it for gas storage. This gives the company six underground facilities in that state.

... **Natural Gas Storage Co.** of Illinois will develop the Cooks Mills gas field in Coles County, Illinois. It will hold 2,000,000 M.c.f. The firm operates the huge 90,000,000 M.c.f. Herscher field reservoir in Kankakee County, Illinois, one of the largest in the nation.

... **Laclede Gas Co.'s** underground storage has made it possible to add 5,000 more installations to the gas-heating load this year.

Capacity of the Florissant aquifer in St. Louis County, Missouri, has been increased to 50,000,000 M.c.f. —more than double last year's capacity. Storage in mid-April at the end of the heating season was 2,600,000 M.c.f.

Other firms will undertake new developments but haven't decided where or when.

Colorado Interstate Gas Co., which has no storage now, is "surveying all possibilities in an attempt to develop storage if feasible."

Consolidated Gas Utilities Corp., which stores gas in Kansas and Oklahoma, "plans additional storage projects in the future as conditions warrant their needs."

Cities Service Gas Co. has upped its capacity in Kansas, and will convert one or two more fields within the next year or so.

New customers . . . The American Gas Association says the nation added 10,000 miles of transmission lines in 1956 to help take care of the 2,000,000 new gas customers in the nation. Heavy new demands are reflected in reports from gas companies.

One of the companies which takes gas from the big Herscher storage in Illinois is Northern Illinois Gas Co. On the January 16 peak day, this company withdrew 92,000 M.c.f. from the field.

But officials say that "total daily amount available to Northern Illinois Gas during heating season remains limited. Herscher is operated satisfactorily but at a rate considerably below the daily and season capacities originally anticipated."

Behind the need for more storage is the number of new gas users which Northern Illinois has to serve. In 1956 the company connected 37,500 new customers — a 1-year record for the firm.

President Marvin Chandler said the most challenging problem is "our gas-supply situation, both current and long term."

To meet peak demands, Northern Illinois is continuing its search for geologic structures in northern Illinois similar to the Herscher dome. Its suppliers are hopeful that certain depleted gas and oil fields might be developed downstate.

At least one field downstate has not panned out as well as was expected. Mississippi River Fuel Corp. had planned a 12-billion capacity storage at Waterloo in Monroe County Illinois, near St. Louis.

But the formation leaks, and the company is still "experimenting" to determine if the project will work.

Consolidated's growth . . . One of the biggest systems in the nation is operated by Consolidated Natural Gas Co., the parent of five distributing firms. Officials complain of the "discrepancy in peak and average day requirements," although one of its subsidiaries, East Ohio Gas Co., has the biggest storage in the world — the Stark-Summit reservoir with a capacity of 148,514,000 M.c.f.

The "discrepancy" is the reason for such projects as N.Y.S.N.G.'s big Woodhull proposal.

Besides N.Y.S.N.G. and East Ohio, Consolidated operates People's Natural Gas Co., Hope Natural Gas Co., and River Gas Co. Together they handle 26 underground storage fields in four states.

Last year the reservoirs held 277,340,000 M.c.f. About 70 per cent of this gas comes from the Southwest, purchased in uniform daily quantities. Peak winter days in 1957 required 2,441,000 M.c.f. daily. This compares with the summer-day low of only 521,000 M.c.f., when demands of 883,000 house-heating customers drop.

How did storage help meet winter demand for Consolidated? In 1956, storage supplied 28 per cent of total customer requirements throughout the heating season.

On peak days this jumped to 48 per cent.

Increase in the number of customers adds to the great seasonal fluctuation of demand "and requires that storage capacity and related facilities be enlarged," Consolidated told stockholders.

The company has already budgeted big sums to take care of this discrepancy. For instance, last year the system spent $5,700,000 for increased compressor-station capacity at storage fields, for additional wells for rapid withdrawal, and for pipeline additions and improvements to handle the larger volumes.

To illustrate increasing demand, Consolidated's subsidiary, People's Natural Gas Co., added 9,000 new domestic gas-heating customers in 1956. An estimated 7,000 more will be connected in 1957.

West Coast . . . Storage capacities come big in the East, as shown by the nation's three leading storage states: Pennsylvania, with 391,870,819 M.c.f.; Ohio, with 361,158,000 M.c.f.; and West Virginia, with 282,817,967 M.c.f.

But gas storage in heavily populated

World's Largest Globe: The huge Hortonsphere at Savannah, Ga., does double duty. A Girl Scout troop, dwarfed by the globe's size, takes a geography lesson. The sphere also stores 600,000 cu. ft. of gas for South Atlantic Gas Co.

California is also paying off in a big way. The industry will have spent more than $55 million in underground storage facilities by 1958.

Pacific Lighting Gas Supply Co., which operates four big projects near Los Angeles, sees an increasing demand for storage in the years ahead. California's future population increase is estimated at 500,000 per year.

To take care of new customers, southern California is importing more and more out-of-state gas. By July 1 out-of-state gas deliveries will exceed 1,640,000 M.c.f. daily. Pacific Lighting predicts that this will jump to 1,880,000 M.c.f. by January 1958, and will climb to 2,080,000 M.c.f. by January 1959.

Pacific Lighting and its subsidiaries, Southern California Gas Co. and Southern Counties Gas Co., say they will have to provide additional peak-day gas at a rate of 100,000 M.c.f. daily per year. They will need more storage to do this.

The problem is finding the right kind of field as close to the Los Angeles population as possible. Big La Goleta field in Santa Barbara County holds 14,400,000 M.c.f. But it is more than 100 miles from Los Angeles, and investment in transmission facilities almost equals the amount invested in the storage project.

Other storage pools are located closer to Los Angeles. The newest one is Montebello field in Los Angeles County. With a planned capacity of 12,500,000 M.c.f., it will be ready for use next year. Only a mile and a half of pipeline had to be laid to connect the storage to the main distribution system.

But the one serious disadvantage to the facility had to do with the proximity to the city. It took Pacific Lighting 2 years to unitize the project, since there were more than 400 leaseholders in the area.

Raymond W. Todd of Pacific Lighting says that long-term storage agreements are being negotiated with operators of pressure-maintenance and gas-cycling projects. So far this type of storage has been tried only on a limited basis in southern California.

Todd points out two big advantages in using pressure-maintenance projects as storage reservoirs: There would be no unitization problems, and the stored gas would help the operator in his secondary-recovery program.

Pacific Northwest . . . Last winter marked the entry of natural gas into the Washington-Oregon area. Pacific Northwest Pipeline Corp. completed its 1,481-mile gas line.

This natural gas will be supplemented by Canadian gas when Westcoast Transmission Co., Ltd., completes its 650-mile line from the Peace River producing area.

Pacific Northwest has no natural-gas storage at present but is making plans for the future.

Pleasant Valley Oil & Gas Co., a subsidiary of British Columbia Electric Co., Ltd., reportedly has plans to develop a 35,000,000 or 40,000,000 M.c.f. storage project near Bellingham, Wash., at a cost of $2 million or more.

If this develops, it will be the first storage for this part of the nation. When it develops is another question.

Reserves . . . Despite the threat of federal controls, nearly all gas-producing states chalked up substantial increases in gas-well drilling in 1956. Over-all increase was 14 per cent. There were 469 successful wildcats in 1956. This is 116 more than the previous year.

Natural gas reserves soared to 237.8 trillion cubic feet last year—a gain of 14.1 trillion cubic feet over the previous year. This is the largest net gain in reserves ever recorded by the American Gas Association for 1 year.

Marketed production increased 9.3 per cent over 1955. Texas accounted for more than half of the production and has nearly half the proved reserves. The Gulf Coast offshore fields are emerging as a big new source, but much of this is potential since lack of pipeline connections deters further development.

Underground storage continues to be an important link in a healthy, stabilized natural-gas industry. As demand grows, gas companies will continue their search for depleted gas fields with closed structures, high permeability, and porosity, near populated areas.

And if last year's expansion is a criterion, next year will mean still more gas storage for peak winter days.

C.A.T.C. Deal Cleared

● But FPC comes up with an unusual arrangement. It sets initial offshore-gas price at 17 cents, provides for an increase in 24 hours with this hike subject to refund

WASHINGTON.—The initial going price for outer Continental Shelf natural gas will be somewhere between 17 and 21.4 cents per 1,000 cu. ft., plus the Louisiana gathering tax.

This was indicated last week when the Federal Power Commission approved the sale of gas by the C.A.T.C. group to Tennessee Gas Transmission Co. A temporary certificate for the sale of more than 6 trillion cubic feet of gas over the next 20 years was issued by the FPC last month, but the question of price was left up in the air *(The Oil and Gas Journal, April 29, page 116).*

C.A.T.C. asked for an initial price of 22.4 cents per 1,000 cu. ft., including the 1-cent gathering tax, with periodic increases beginning in 1962. The FPC cut the initial rate to 18 cents, including tax. But it is allowing the group to file for a rate increase to be effective one day after deliveries begin.

The increase will be suspended by the FPC, but for only 24 hours. Then it may be put into effect, subject to refund.

Course explained . . . This rather unusual approach was taken by the FPC to enable T.G.T. to go ahead with the building of a pipeline to bring the gas to shore.

It originally remanded the price issue to an examiner. But the companies said this would involve economic risk they could not take.

They explained that they couldn't present their case quickly and couldn't afford to commence construction until an initial price was set. And it is necessary to get the line building immediately if deliveries are to start November 1, as planned.

The producers argued that the FPC would have continuing control over rates under existing law. They promised to revise their contracts to provide continuing supervision over future price increases if the Harris bill is passed.

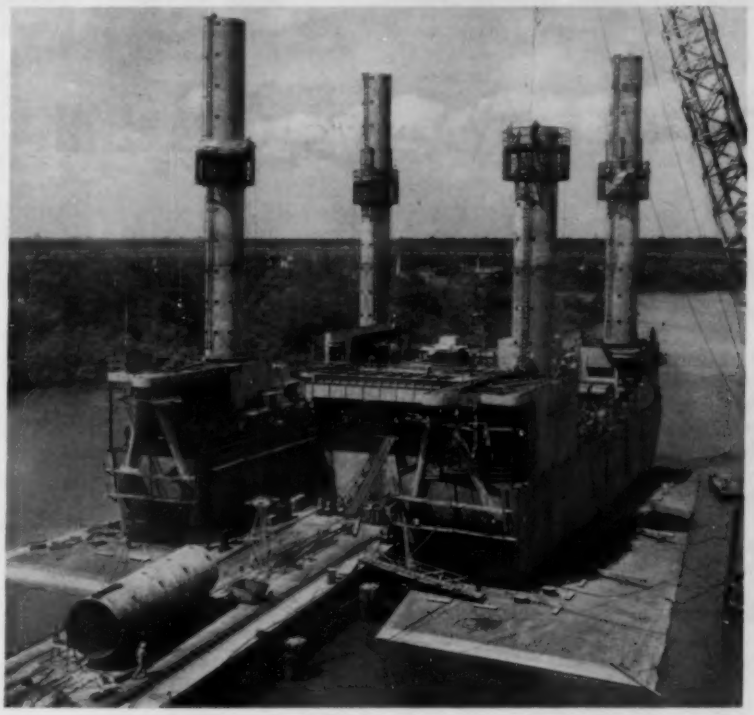
The commission, on the other hand, insisted that the interest of consumers must be protected not only as to future prices but as to the initial price. It pointed out that under the Harris bill "the proposed initial price might no longer be subject to adjustment by us."

The FPC made it clear it is not ruling that the 17-cent rate is the proper price for C.A.T.C. gas. The FPC said it is merely setting up a means of protecting the public while at the same time giving the producers and the pipeline the opportunity to go forward with construction.

The FPC has the power to suspend rate increases for 5 months. But it is limiting the suspension in this case to 24 hours to assure the producers that they will not be penalized by the suspension action.

Any price fixed by the FPC under this arrangement will hold until November 1, 1962. The producers then may file for indefinite price increases for any of the subsequent 4-year periods. These increases are not to be more than 2 cents for each succeeding period through 1978, when the top price, excluding gathering tax, will be not more than 29.4 cents.

The FPC also ruled that if the contracts run beyond November 1, 1978, there may be two further increases at 4-year intervals. But after 1986 the price is not to exceed 35.4 cents until expiration of the contracts.



Designed to tackle water 150 ft. deep . . .

"Mr. Gus II" Almost Ready

BEAUMONT.—"Mr. Gus II," largest mobile drilling platform ever built, will be commissioned here May 31.

The vessel is designed for drilling in water as much as 150 ft. deep. It will cost about $6½ million.

Built by the shipbuilding division of Bethlehem Steel Co. at Beaumont, the platform will be owned and operated by C. G. Glasscock Drilling Co., Corpus Christi. It is an enlarged and modified version of the original "Mr. Gus" which recently capsized.

Bethlehem officials said that the new vessel represents "the culmination of a 10-year design and research program to explore for oil in deeper water and farther offshore than ever before attempted." Deepest water yet tested by a mobile rig in the Gulf of Mexico is about 100 ft. The water-depth record for a stationary platform is 112 ft.

Work on "Mr. Gus II" started more than a year ago. Its upper deck measures some 258 by 104 ft., and the foundation platform is 180 by 200 ft.

FOUR DIMENSIONS of gas fight were given by panelists Hedrick, Connole, Heyke, Rowan.

TIPRO Accepts Gas Bill—Somewhat

GALVESTON. — Reluctant support for the Harris-O'Hara gas bill, provided certain amendments can be made, has come from Texas independents.

The Texas Independent Producers and Royalty Owners Association at its annual meeting here flatly refused to accept the bill if it includes two amendments proposed by the Eisenhower administration.

Instead TIPRO seeks a series of amendments to the bill which would:

. . . Eliminate the prohibition on state action affecting conservation and intrastate-gas prices.

. . . Place the burden of proof on complainants rather than on sellers.

. . . Permit two-party, favored-nation escalation clauses.

TIPRO hinged its support of the measure on acceptance of these changes. If they are refused, organization officials were authorized to withdraw support and seek deferment of congressional action until an improved bill can find acceptance.

The membership was sharply divided on the resolution. Many officials openly opposed the bill even with the TIPRO amendments. They did not agree that this is the producers' last chance and that they must take this bill or nothing.

This conditional approval came after 2 days of debate. Many producers denounced the bill as an unwarranted surrender to the principle of federal regulation. Feeling also ran strong among independent producers that if they hold out a couple of years the supply of gas in interstate commerce will become so short that more favorable legislation can be passed.

Main feature of the debate was a panel discussion representing the "four dimensions" of the gas industry: the public, transporter, distributor, and producer.

Panelists were Commissioner William R. Connole, the Federal Power Commission; Joseph J. Hedrick, president of Natural Gas Pipeline Co. of America, Texas Illinois Natural Gas Pipeline Co., and Independent Natural Gas Association of America; John E. Heyke, president of Brooklyn Union Gas Co. and chairman of the Council of Local Gas Companies; and Arch W. Rowan, Fort Worth producer and chairman of TIPRO's gas committee.

The FPC position . . . Connole took little part in the debate other than to answer a question about favored-nation clauses.

He said the commission opposes them because they make it impossible for distributors to have any idea what their price will be at any time in the future. He said growing demand for gas will raise prices; but if they go up too fast, such as by triggering favored-nation escalations, gas will be priced out of many markets.

Connole's main point — and one which the producers had difficulty accepting—is this: Gas has become so essential that its production is now affected with the public interest. FPC must sit in to protect that interest. Due to the explosive growth of the industry since the war, he said, the three elements of the industry were not aware of each other's problems, but now they must become so.

"The fact of life that we must both face is the fact of federal regulation," Connole said. "The FPC must consider the three dimensions of the industry — production, transportation, and distribution—and also a fourth dimension. That is the dimension which measures the extent of the public interest.

"The producing industry now occupies a position where it can no longer be operated exclusively for the personal and private profits of its owners.

"The nation can't get along without you. With this privileged position, however, comes a corresponding obligation. You have become subject to the fact of public regulation.

"Speaking for your Federal Power Commission, you can rely on the type of constructive, realistic, progressive regulation in the public interest that you want and require. Ours is the broadest possible responsibility. We are keepers of none but the public trust."

Pipeliner speaks . . . Hedrick said the Harris-O'Hara bill is not entirely satisfactory to the pipelines. The chief complaint: It places on them and the producers the burden of proof for showing that a price is reasonable when consumer interests challenge it.

But he urged support of the bill as being the best compromise that can be obtained and as being better for all concerned than the present situ-

ation. Personally, he said, he favors eliminating producers from federal regulation entirely. He also is opposed to the provision curtailing state action on gas matters.

Favored-nation clauses are opposed by pipelines, Hedrick explained, because a pipeline must operate on averages. If all its purchase prices jump to the highest being paid in an area, the line will lose its markets. The practical result of retaining them would be that a pipeline would not buy any more gas in an area where the entire price might be triggered up by a favored-nation clause.

Asked how much the average consumer would be affected by a 1-cent increase in the field price, Hedrick said this would make little difference in itself. But he explained that in many areas a small increase would lose off-peak industrial sales to coal or oil. If these are lost, the household rate will have to go up many times the increase in field prices.

Unless gas prices itself out of the market, Hedrick said, production must be doubled by 1975 to meet the expected demand of 22.5 trillion cubic feet. The price advantage which gas has enjoyed is narrowing, he warned. In some places the advantage lies with competing fuels.

Since most of the known gas reserves are already dedicated, Hedrick said, industry expansion can come only if producers have adequate incentives for vigorous exploration and production. But, he said, the price cannot jump too fast. He urged producers to work with distributors in promoting steady development of new markets.

Double dealing denied . . . Heyke vigorously denied that distributing companies had any part in "planting" the two amendments proposed by the administration.

He said his group will not support either one, and that they would be injurious to all segments of the industry.

Distributors are not in favor of regulating producers as such, Heyke declared. Anything that is harmful to producers in the long run is harmful to distributors. But, he said, distributors want safeguards against sudden and mass increases in field prices. They are not seeking a price freeze and they anticipate a rising level of field prices.

Opposition to favored-nation clauses, Heyke explained, arose when they did not work out as expected. They resulted in large, wholesale jumps in field prices far beyond any economic justification, and eliminated competitive buying in the field.

In answer to another question, Heyke said the Harris-O'Hara provision restricting state action was not a last-minute idea. It had been discussed frequently by the industry drafting committee. He said its elimination would cost the support of a great many distributors now favoring the bill. He added that a small minority of distributors oppose the bill as it now stands.

The producer talks . . . Rowan explained at some length the cost factors.

They make it inevitable that gas prices must go up if adequate new supplies are to be found—particularly at the greater depths where the newer reserves are being found. Regarding the Harris-O'Hara bill, he said:

"This bill does not free the producer from regulation. It does free him from the type of regulation which the Supreme Court decreed. It does not go as far as I think it ought to go, because I believe the true public interest would be served by letting competition between producers and between gas and other fuels control the price of this commodity.

"However, it does have certain sedatives in it that alleviate the pain of the independent producer to some extent. It will tend to create a better atmosphere. It will quell some of the confusion and frustration. It will empower the independent producer to continue to make his contribution toward supplying the demands of present and future consumers.

"It holds out to him the hope of realizing such profit as will result to him from being able to sell his gas at contract prices which he can rely on, and at the reasonable market value of the gas as a commodity."

In Washington, a deadlock:

No Unity, No Action on Gas Bill

WASHINGTON.—The "2-week" hearing set by the House commerce committee on the Harris gas bill has now limped along for 3 weeks. And the end is not in sight.

Nor is there in view any unity of the opposing factions whose adamant stand threatens to kill the measure. Gas producers still are opposed to the administration's demands for changes. And consumer interests are still opposed to any bill at all.

Senate action on the bill—if the House passes it—has definitely been ruled out for this year.

Sen. Warren G. Magnuson of Washington said the Senate commerce committee which he heads will not take the bill up until next year. There isn't enough time left to handle it this session, he said.

Senate leaders are not eager to get into the fight. They prefer to let the House handle it. If the House passes the bill before the end of the session Magnuson probably will take it up next January.

Action sought . . . Efforts are being made within the committee, meanwhile, to get some sort of agreement that would send the bill to the House floor. There is no indication so far whether they will be successful.

There are no signs that the administration will back down on the two big changes it called for through Charles H. Kendall, general counsel of the Office of Defense Mobilization. It put the label of "consumer protection" on the use of cost by the Federal Power Commission and review of escalations under existing contracts. Now it can't afford to reverse itself, according to experienced political observers.

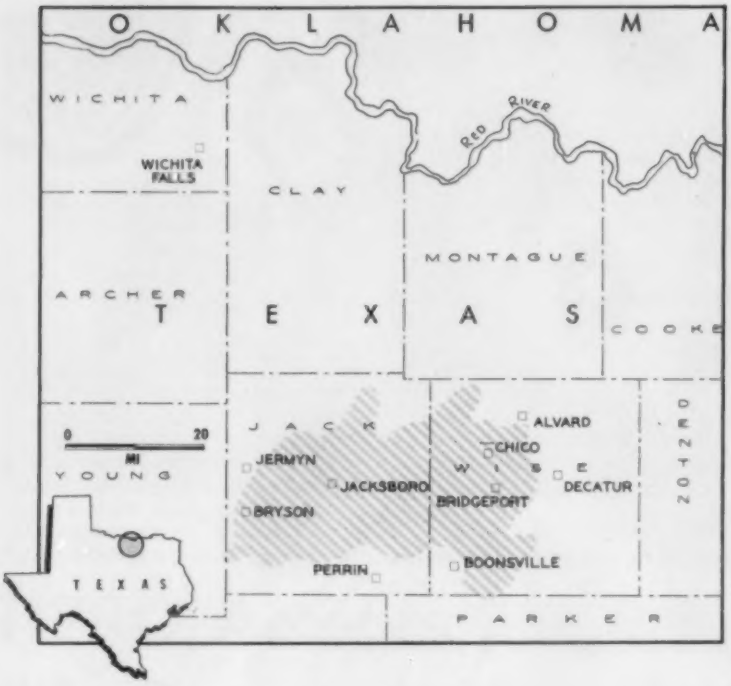
There is talk, however, that the administration may modify its call for review of present contracts. That, plus emphasis that consideration of costs by the FPC would be permissive but not mandatory, might take some of the heat out of the opposition to them.

The committee last week heard the bill strongly supported from the two ends of the gas industry.

Randall J. LeBoeuf, Jr., of Consolidated Edison Co. of New York, said a number of distributing companies which 2 years ago opposed the measure then pending in Congress favor the Harris bill as the only means of preventing the drying up of supplies threatened by the present type of regulation.

From the other end of the industry, Charlton H. Lyons, president of the Mid-Continent Oil and Gas Association, said his 8,500 producer members support the bill as the only type of legislation that can be passed.

Both LeBoeuf and Lyons strongly opposed the administration amendments. They agreed that the net effect would be to put producers under utility-type regulation.



Giant Gas Field Sought

But proposal to create one reservoir with single set of rules from 81 Jack, Wise County fields runs into fight

AUSTIN.—Producers and pipeliners mixed it up vigorously here last week over a proposal to create one of the biggest gas fields in the United States (see map).

Lone Star Gas Co. in a week-long hearing urged the Texas Railroad Commission to create the giant new reservoir by consolidating 81 Bend conglomerate fields now producing in Jack and Wise counties of North Texas.

The resulting whopper would take in 550,000 acres stretching out over an area 35 to 40 miles long and 20 to 25 miles wide. It would surpass in size such present mammoths as the Spraberry Trend area oil field in West Texas and Panola gas field in East Texas.

Lone Star Gas and its affiliate, Lone Star Producing Co. argued that the present 81 fields, though producing from the same reservoir, are regulated differently. It said this has caused inequities and confusion which will mount to the point where the situation will become chaotic.

Lone Star witnesses claimed selective buying and nonratable take on a large scale are inevitable unless the fields are combined.

Opponents contend there is no evidence that the Bend pay throughout this huge expanse is interconnected. They point out that there are only 362 Bend wells in the entire area and that development as yet is far too sparse to warrant any such wholesale combination of fields.

Hearings began May 15 and wound up May 22. The contestants were given 30 days after receipt of transcript to file briefs or closing statements of position. Some operators not testifying at the hearing likely will be heard from then.

About the area . . . The Bend conglomerate in the area now is generally recognized to be a huge stratigraphic trap dipping north-northeast from the Bend arch. It covers most of Jack and Wise counties and a small area in northern Parker County. Geologically, it is in the Fort Worth basin.

It isn't a thick prolific zone, but a group of several conglomerate sandstone stringers and lenses. Some are extensive, some much smaller.

The "Bend conglomerate" term actually takes in all zones between the top of the Caddo conglomerate and the top of the Marble Falls.

The various conglomerate stringers and lenses occur sporadically. Some wells penetrate only one or two, while others encounter 10 or more.

A well normally can't be completed commercially from just one of the stringers. Common practice is to set casing through the section, then perforate and fracture each of the more permeable lenses to improve gas flow. The wells sometimes are acidized.

A few wells were completed as gassers in the 1940's. But the heavy drilling has come within the past few years. The area got its initial impetus when Lone Star completed a line into the area in 1949. But only 19 wells were completed that year, while 73 were completed in 1956.

There are 362 wells in the area, 187 in Jack County and 175 in Wise. Development is in an early stage. Lone Star claims it is less than one-third complete.

Total potential of the 362 gas wells in the area is over 1½ billion cubic feet daily—748,200,000 cu. ft. in Jack County and 848,316,000 cu. ft. in Wise.

Output gaining fast . . . Production last year averaged about 78,000,000 cu. ft. daily. Pipelines of Lone Star and Brazos River Gas Co. took it all with Lone Star piping about 85 per cent.

About 135 of the Bend gas wells are unconnected. But more than two-thirds of them are slated to get an outlet about the first of next February when Natural Gas Pipeline Co. completes a line into the area.

Estimates of Bend gas reserves are rough due to the sparse drilling. But Lone Star thinks its estimate of 2¾ trillion cubic feet will prove close.

It predicts further that Jack and Wise county gas production will rocket up to 325,000,000 cu. ft. daily within the next few years.

Biggest acreage holders are Christie, Mitchell & Mitchell of Houston, with a reported 250,000 acres, and Lone Star Producing, with about 40,000 acres. Others active are Sunray Mid-Continent Oil Co., Warren Petroleum Corp., and a large number of independents.

The Lone Star side . . . Lone Star presented contour maps and other exhibits to prove that at least 251,000 acres of the conglomerate pay is interconnected, either naturally or through man-made multiple completions.

The company is unable to show correlation through the rest of the area but thinks further development will disclose such.

Fast spreading of the present mul-

tiple Bend fields has created some ridiculous situations, Lone Star claims.

One, it points out, is where Cottondale field has been extended so as to completely surround Bridges field in Wise County. The two have different spacing patterns and proration formulas. Such situations, it says, violate correlative rights and ratable take.

Lone Star points out that 9 of the fields with 132 wells are producing under special rules, while the other 72 with 230 wells operate under the regular state-wide rules.

There is 660-ft. spacing in two fields, 467-ft. spacing in seven, and 330-ft. spacing in the other 73.

Generally, Lone Star says, the fields with the special rules get a big allowable break. These can produce up to 100 per cent of their potentials, while those under state-wide rules can produce only 25 per cent.

An operator who wants to drill a well between fields prorated differently doesn't know how big an allowable he'll get or what spacing pattern he will be required to follow.

The company contends that the special-rules fields are producing more than their share of Bend gas and in some cases draining those on state-wide rules.

It lists fields operating under special rules as Cottondale, West Chico, Morris, Alvord, Boonesville, Wizard Wells, Cottondale East, Ken-Rich, and Bridgeport.

It asks that the commission combine the entire area and regulate it under the rules now in effect in Boonesville field. It would add one extra rule to protect oil wells producing in the same stringer as gas wells. A gas well in this type of stringer would be assigned a displacement allowable if within 1 mile from an oil well. Such an allowable couldn't be assigned, however, until after a hearing.

The proposed rules would provide for 467 to 2,000-ft. spacing, 320-acre proration units, an acreage-times-bottomhole-pressure proration formula, and treatment of the various conglomerate stringers as one reservoir.

The opposition . . . Lone Star's prime opponent at the hearing was Christie, Mitchell & Mitchell.

Others opposing part or all of the application were Southern Union Gas Co., Ambassador Oil Corp., Kerr-McGee Oil Industries, Inc., American Trading & Producing Corp., and several royalty owners.

Christie, Mitchell & Mitchell presented seismic contour maps which it said showed a fault separating the southeast part of the area from the rest. It said the fault separates the Boonesville area on the west from the Cottondale-Paradise area.

The company argues these areas are not connected, that any man-made connections of stringers would not cause communication between the two areas.

Martin G. Miller, Houston consulting engineer retained by C.M.&M., offered a series of exhibits as proof that the Bend gas wells in Jack County could be produced to depletion without affecting wells in eastern Wise County.

C.M.&M. offered two separate sets of rules for the two areas. They are essentially the same as those proposed by Lone Star for the entire area.

Old war . . . C.M.&M. regards the current hearing as merely a new battle in an old war.

The company sided with Natural Gas Pipeline against Lone Star in a bitter 3-year struggle before the Federal Power Commission over whether N.G.P. would build a line to and purchase gas from C.M.&M. and others in the Jack-Wise area.

FPC approved the Natural Gas pipeline and turned down a competing proposal by Lone Star *(The Oil and Gas Journal, December 10, 1956, page 90).*

C.M.&M. points out that its wells would suffer and Lone Star's would gain under Texas prorating if the Jack-Wise producing area is joined into one field.

In Texas, pipeline purchasers' demand for gas from a field actually becomes the allowable. The total pipeline demand for gas from a field generally is distributed to each well in the field according to its proration formula.

If the 81 Bend conglomerate fields were combined, C.M.&M. points out, Lone Star would gain a large share of total gas produced for Natural Gas Pipe Line, which it has been fighting to keep out of the area. As things are now, Lone Star would get none.

C.M.&M. charges this is Lone Star's sole motive in pushing for consolidation. Faced with this charge at the hearing, E. A. Brown, Lone Star vice president, said this wasn't the reason "though it would be a result and, we feel, a good one."

New Williston Line Studied

WILLISTON, N. D.—Preliminary studies indicate a new crude pipeline out of the Williston basin is feasible.

Great Northern Railway Co., which is interested in transporting crude by rail and pipeline, proposes to build the line.

Service Pipe Line Co. operates the only line serving the basin. It supplies the 33,000-bbl. Mandan, N. D., refinery of Standard Oil Co. (Ind.).

Great Northern would serve unconnected wells whose production is now being trucked or shipped by rail as well as new production which is being developed. Interest is focused on deep tests below established pays in Beaver Lodge field and a strike in northeastern Montana by Amerada Petroleum Corp. *(The Oil and Gas Journal, November 26, 1956, page 48).*

Line details . . . Tentative planning points to a 12 to 20-in. line 400-600 miles long. It would run from northwestern North Dakota or northeastern Montana to a point in Minnesota. The alternate destinations are St. Paul-Minneapolis and Clearbrook. At Clearbrook the line could tie in with the Minnesota and Lakehead pipeline system to the twin cities and Duluth-Superior areas. If future production warrants, the line could be extended to Chicago.

A survey of reserves and producing capacity by Keplinger & Wanenmacher, Tulsa petroleum engineers, indicates possible throughput of 25,000 to 30,000 bbl. per day.

Pipe Line Technologists, Inc., Houston, is expected to wind up its feasibility study in July or August. The decision on whether to build the line will be made then.

The line would follow Great Northern's right-of-way, which would simplify construction and reduce costs. The railroad said it might finance the project out of its own earnings rather than by borrowing. Estimated cost would be $20,000,000 to $25,000,000.

Market . . . Market for the crude would be Minnesota and Wisconsin refineries which are now operating increasingly on Canadian crude.

The plan is for Williston to supplement—not supplant—this supply. Williston producers are eager to break out of their limited market area. And the refiners would like a domestic crude source—in addition to imports—on which to base long-range expansion plans.

Great Northern says the line will be based on the highest possible wellhead price to producers. A combination long-haul rail and pipeline rate will be charged for crude from fields not connected to the gathering system.

Wage Pattern Firmed

Sinclair joins others in offering 6 per cent increase. Principal problem now is agreement on effective date

IF there was any doubt about the industry's wage-increase pattern, it was removed last week.

Sinclair Oil Corp., which has the only nationwide union contract, offered a 6 per cent increase, joining other majors who had made the same offer as far back as 2 weeks ago.

The big Oil, Chemical and Atomic Workers Union, which represents Sinclair employes, already had said it would accept the 6 per cent, provided other provisions could be agreed upon.

This means that workers generally will be making 16 cents more per hour, plus 2 cents in fringe benefits. These include eight annual holidays, double time and a half for holiday work, and 4-week vacations after 20 years.

Disagreement . . . The only major disagreement remaining between O.C.A.W. and the oil industry is the effective date of the pay hike.

Some firms had offered nonunion workers 5 per cent effective April 1, and then increased it to 6 per cent, effective May 1, when O.C.A.W. indicated it would accept a 6 per cent offer.

This means that in some cases nonunion workers would get their raise a month earlier than O.C.A.W. members.

O.C.A.W. President O. A. Knight said this is discrimination against the 105,000-member international union.

Some tentative agreements have been reached with O.C.A.W., based on 5 per cent effective April 1, and 6 per cent effective May 1, including The Texas Co., at two Gulf Coast plants.

But Sinclair, Shell, and Tidewater last week held out for 6 per cent effective May 1, O.C.A.W. has demanded January 1 as the effective date with Sinclair.

Federation acts . . . The 30,000-member Federation of Independent Oil Unions last week endorsed the new national pattern, although the 18-cent "package" is well below the 25 cents originally demanded by F.I.O.U., and the 27 cents demanded by O.C.A.W.

Some segments of the loosely knit F.I.O.U. weakened earlier in the year. The 6,300-member Independent Petroleum Workers of America accepted a 4 per cent wage increase from the Standard Oil Co. (Ind.) refinery at Whiting in March. Another Indiana Standard group—the 12,000-member Central States Petroleum Union—accepted 5 per cent.

F.I.O.U. was formed 1½ years ago to keep small independent unions from being swallowed up by the big O.C.A.W.

O.C.A.W. loses out . . . O.C.A.W. suffered a setback last week at Esso Standard Oil Co.'s refinery at Linden, N. J.

A surprise vote of 1,948 workers at Esso's big Bayway refinery there rejected affiliation with the A.F.L.-C.I.O. union. The vote was 1,123 in favor of sticking with the Independent Petroleum Workers and 825 for hooking up with O.C.A.W. The election was conducted by the National Labor Relations Board. A total of 2,124 employes were eligible to vote.

"We will renew our organization efforts," an O.C.A.W. spokesman said at the union's headquarters in Denver.

The union had been given a better than even chance of winning the election in view of preliminary voting April 5 in which 2,074 Bayway workers favored affiliation with the union 1,105-969. Esso refused to recognize O.C.A.W. pending certification of the union in an N.L.R.B. election.

The outcome of the voting was a blow to the union. O.C.A.W. had hoped to use the Bayway plant as a springboard to Esso's other five refineries, three in the East and two in the South. Total capacity is 653,000 bbl. daily. Esso refinery workers are represented by independent groups exclusively.

Gasoline Tax Goes Higher in a Hurry

OKLAHOMA CITY. — Oklahoma increased its tax on gasoline by a cent a gallon last week in a whirlwind action seldom seen in lawmaking circles.

In less than 36 hours the measure was introduced, rushed through both houses, and signed by Gov. Raymond Gary.

It was drawn up hurriedly at the request of Gov. Gary to provide emergency funds for repair of roads damaged by recent heavy rains and floods. It increases Oklahoma's tax on gasoline, already among the highest in the nation, to 7½ cents.

The law goes into effect June 1 and dies automatically at the end of the year. The governor can cancel it anytime during that period.

Alaska Leases Eyed

Bill proposes to open up promising offshore area

WASHINGTON.—Opening of a no man's land which is believed to hold most of Alaska's oil wealth is being pressed in Congress.

A bill to permit the leasing of Alaska's submerged lands is backed by territory officials and interested companies. The Interior Department supports the idea, but differs over how it shall be done.

Alaska has approximately 57 million acres of submerged lands. Of this 42 million acres lies between the high-water mark and the 3-mile limit. The remaining 15 million acres is covered by nontidal navigable waters. With the exception of the Kateel River area all current oil and gas drilling is on leases near these submerged lands.

Oil development in the underwater area is impossible now because nobody has authority to issue leases. The territory does not have title to the lands. The titles are held by the federal Government. The Government can't lease because it holds the lands in trust for the future state of Alaska.

Contents of bill . . . The bill now before Congress would allow the Secretary of the Interior to lease the underwater lands under the Mineral Leasing Act of 1920. The same acreage limitations would apply as are now used for leases on the Alaska uplands. Ninety per cent of the proceeds from leases would be returned to the territory.

The measure would be a temporary step. If and when Alaska becomes a state or otherwise acquires title to the lands it would apply its own leasing law. But leases now made would not be affected by the change, except that rental and royalty would be paid direct to the Alaskan government.

Interior officials agree that Alaska's oil should be developed. But they believe there should be two bills. One would apply the Mineral Leasing Act to the navigable waters. The other would subject the offshore area to the provisions of the Outer Continental Shelf Act.

Service Expanding

Big crude carrier takes over Utah Oil pipelines

TULSA.—Service Pipe Line Co. has made another consolidation move by purchasing crude pipelines of Utah Oil Refining Co., which, like Service, is a subsidiary of Standard Oil Co. (Ind.).

The change takes effect June 1, with 130 employes being transferred to Service. Service absorbed American Oil Pipe Line Co. in a similar move last February.

The Utah lines, totaling almost 1,000 miles, transport some 50,000 bbl. per day to Utah's Salt Lake City refinery, to connecting pipelines there, and to Salt Lake Pipe Line Co. at Rangely, Colo. The Utah acquisition will expand the Service system, already the world's longest, to about 15,000 miles in 15 states. Service will gather 660,000 bbl. per day and deliver more than 800,000 bbl. per day, including crude received from other pipelines, for shipment to 51 refineries.

Service built the line for Utah in 1939 and operated it until it became a department of Utah Oil Refining January 1, 1949.

The Utah system, first to cross the Continental Divide, originally ran from Fort Laramie, Wyo., where it tied in with Service, to the Salt Lake City refinery. After World War II, feeder lines were laid from Rangely and other fields in northwestern Colorado to the main line at Wamsutter, Wyo. Crude moves eastward from Wamsutter into Service pipeline and westward into Salt Lake City.

Louisiana Dome Produces

SHREVEPORT. — North Louisiana's first salt-dome discovery has been completed by Pan American Petroleum Corp.

The 1 Anna Hudson had a calculated open flow of 9,000,000 cu. ft. of gas per day with 13 bbl. of 58°-gravity distillate per million cubic feet.

The well is 30 miles northeast of here in Webster Parish. Production is from perforations in the Paluxy sand at 7,460-66 ft. The deeper Cotton Valley at 9,490-6,612 ft. also had commercial production, but the operator has not completed in this zone.

Pan American has full interest in the well and in 5,000 acres surrounding it.

The strike is off the east flank of Minden salt dome, one of several in the basin between the Sabine and Monroe uplifts. *(For map, see page 318.)*

watching WASHINGTON

. . . with Bertram F. Linz

Gray walks a tight rope . . .

MOBILIZATION DIRECTOR GORDON GRAY is in search of the ideal plan to limit oil imports. That would be one requiring neither formal government order nor antitrust immunity.

Gray has met with officials of a half-dozen companies so far. He also has talked with the Independent Petroleum Association of America. But at the rate the meetings are going on it will be midsummer before he knows just how far some 60 or more importers are willing to go to head off the threat of government import control.

Gray is working on the premise that each company can limit its own imports without regard to what other companies are doing. In this way he would avoid anything in the way of concerted action that would be legal only if the Justice Department gave it clearance.

This course is believed to be in line with the importers' thinking. They are as anxious to avoid the shoals of a voluntary program policed by the Government as they are to avert the peril of governmental control.

Gray told a news conference the issue of antitrust immunity had not been raised in his talks so far. But it has come up in congressional and other circles.

Gas bill short on votes . . .

THERE'S more behind House leaders' apathy on the gas bill than just resentment over the administration's tactics. A poll of the House shows that the bill right now couldn't raise enough votes to pass.

The count was based on the 1955 vote of members still serving and a survey of new members elected last year. It came out that the bill would lack six votes necessary for it to pass. And it was by that slim margin that it got through the House 22 months ago.

The odds against the bill could be even greater, however. A number of members who voted for it before say they will think hard before going on record for it again. When it was vetoed last year consumers sided with the President, and congressmen took the blame for voting wrong.

Even members from gas-producing states will be cautious this year unless there is definite promise from the White House that the bill will be signed. And since the bill doesn't please either producers or consumers they will have a good excuse for not going along with it.

As one man who had a tough time getting reelected put it: His district has scores of gas producers, but scores of thousands of consumers. There will be another election next year. And the number, not the origin, of votes is what counts.

Emergency line fading . . .

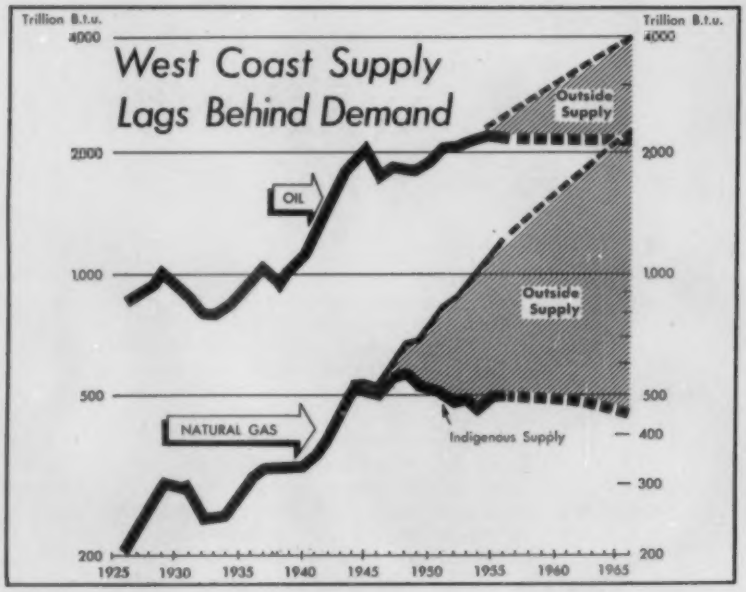
THE odds on the fight over who shall build the long-talked Texas-East Coast pipeline have shifted once more. This time they are against the American Pipe Line Corp. Only a few weeks ago that company seemed to have an inside track.

Government backing for the American line is still being studied, Mobilizer Gordon Gray reports. But there's a lot of opposition to the project by water transporters and others, he says. And now a new factor has popped up. Here's how the issue stands at the moment:

Texas Eastern Transmission Corp. expects soon to get Federal Power Commission approval for conversion of the Little Inch line from gas to products. That would take care of a big segment of the Texas-East Coast route.

A new products line from Philadelphia to Cleveland is planned by Laurel Pipe Line Co. In an emergency, it could be reversed. That would cover the defense angle which is back of the idea for a new long line.

Neither the Little Inch nor the Philadelphia-Cleveland line would call for government aid. American needs that help to get rolling.



Trouble in the West

More people and less production mean five growing states will be supplying only 45 per cent of own needs by 1966

LOS ANGELES.—The West Coast can't produce enough domestic oil and gas to meet its soaring needs now. But its plight will grow much worse faster in the next 10 years.

This outlook for the five western states was given by Kenneth Hill, vice president of the Chase Manhattan Bank, in an address here before a meeting of the American Petroleum Institute's Division of Production. His talk was based on a survey of California, Oregon, Washington, Nevada, and Arizona he made with Harold D. Hammer, assistant vice president of the bank, and John G. Winger, the bank's petroleum economist.

The West Coast energy situation is this: The oil and natural-gas industries now supply 90 per cent of the area's energy demand. This demand will increase 5½ per cent in the next decade. This means a daily requirement of 1,850,000 bbl. of oil and 6 million cubic feet of gas by 1966. Thus 10 years from now the industries will be called on to supply 94 per cent of the West's energy needs.

But what of supply? Hill declared the region's ability to take care of its own needs from home-produced supplies will decline. California oil and gas fields now supply 72 per cent of the West Coast's energy requirements. Only 10 years ago, California met 98 per cent of the demand. In 1966, it will be able to furnish only 45 per cent of the need.

This two-fold problem of soaring demand and declining production stem from these factors:

... An explosive population growth in years after World War II.

... A sharp decline in production of crude and gas in California since the Korean War.

The obvious result has been the ever widening gap between production and demand.

Population booms . . . The five-state area on the coast is growing three times faster than other areas.

Hill estimated this growth rate is expected to continue during the next 10 years.

Geography also complicates the population burden in this way: It has created a transportation requirement all out of proportion to average needs in the rest of the nation. The factors are:

... Lack of adequate public transportation systems. This has thrown an enormous transportation burden on private automobiles.

... A favorable climate and plenty of beautiful natural scenery. This has increased private motoring.

The upshot has been that motorists in the West just use more gasoline per capita than Americans in other sections. California, in fact, has led the nation in gasoline consumption for 12 years.

Westerners also own more automobiles. In the rest of the country, automotive requirements account for only 15 per cent of the total energy demand. On the West Coast they account for nearly 25 per cent.

There are now 9 million registered vehicles in the five western states for a population slightly exceeding 18 million. By 1966, there will be 15 million vehicles for an estimated population of 26 million persons.

Crude outlook . . . At the present, crude oil fills about 60 per cent of total energy demand on the West Coast. This percentage is expected to remain the same (see chart).

Hill reported, however, that in terms of crude this will represent a tremendous jump in demand. This means that the West Coast will have to import nearly a million barrels

West Coast Energy Supply and Demand

	1946	1956	1966	Change from 1956 to 1966 per cent
	Trillion B.t.u.			
Demand	2,645	4,055	6,545	+ 61.4
Supply—				
Liquid petroleum:				
Indigenous production	1,940	2,198	2,185	— 0.6
From outside sources	35	517	1,910	+269.4
Subtotal	1,975	2,715	4,095	+ 50.9
Natural gas:				
Indigenous production	505	525	455	— 13.3
From outside sources	25	695	1,815	+161.2
Subtotal	530	1,220	2,270	+ 86.1
Water power	105	225	320	+ 42.2
Solid fuels	315	200	70	— 65.0
Total supply	2,925	4,360	6,755	+ 54.9
Less: Shipments and stock increment	280	305	210	— 31.1
Net energy supply	2,645	4,055	6,545	+ 61.4

daily to meet demand of 1.8 million barrels. Hill predicted California's onshore production then will have dipped to 860,000 bbl. daily.

California is now producing at capacity and has produced half of its ultimate onshore reserves, according to the bank study. Current production is on a reserve-production ratio of 10:8. In order to keep up this pace and meet a growth in demand of 4.9 per cent annually, California operators must find 1.5 bbl. of new oil for every barrel produced. They have failed to do this for the last 18 years.

Offshore production, meanwhile, is not taking up any of the slack in oil supplies. Recent delays in leasing have thrown original estimates out of kilter. Statisticians thought offshore production would hit 50,000 bbl. daily by 1960 and 120,000 bbl. by 1965. These estimates have been scaled down to 35,000 bbl. by 1961 and 100,000 by 1966. Hill estimated that offshore production would peak at 200,000 bbl. daily sometime between 1975 and 1985. Offshore reserves have been estimated at 3 billion barrels.

The role of gas . . . Natural-gas production in the west is also fighting a losing battle with that region's soaring needs. The natural-gas decline started in 1948, even earlier than that for oil.

There have been no really large-scale natural-gas discoveries in California since World War II. The region actually is importing more gas from other states than it produces.

Natural gas now supplies about 30 per cent of the region's total energy requirements. This role is expected to increase slightly in the next decade if economics still makes it possible to move gas considerable distances at a profit.

Naturally the volume of gas consumed will skyrocket to keep the same percentage. Consumption thus is expected to rise 86 per cent in the next 10 years. This will require tremendous investments for exploration, development, and pipelines in both the United States and Canada.

Rely on petroleum . . . The role of crude and natural gas in the energy picture of the western states is greater than in other sections.

Hill gave these statistics to prove the point: Oil and natural gas now supply 90 per cent of total energy sources on the coast. Water and solid fuels split the remainder. But in the rest of the country, crude supplies 42 per cent of energy needs, natural gas 23 per cent, coal 31 per cent, and water 4 per cent.

Pipeline briefs

Federal Power Commission hearings on Midwestern Gas Transmission Co.'s battle for a new gas line in the Midwest continued last week with a Justice Department attorney an interested observer.

There is no indication whether the department is looking for evidence of collusion in the opposition to Midwestern's project. The department has authority under the Natural Gas Act, however, to investigate possible violations of the antitrust laws in the natural-gas industry.

The FPC previously had heard charges that Midwestern's competitors are motivated more by a desire to block the project than by any sense of responsibility to themselves to provide service in the area.

Pipeline companies which failed to protest Texas' ill-fated 1951 natural-gas gathering tax appeared near to getting that tax money back last week. These companies paid $5,700,000 before the tax was declared unconstitutional. A refund bill has been passed by the Texas Legislature. Small claimants will receive $842,633 immediately. El Paso Natural Gas Co., United Gas Pipe Line Co., and Tennessee Gas Transmission Co. receive a 10-year credit against other state taxes.

Gulf Refining Co. is nearing completion on its L.P.G. pipeline system from West Texas and New Mexico to Mont Belvieu in the Houston area. The system will total more than 600 miles. Gulf is laying 50 miles of 6-in. and 40 miles of 8-in. from Monument, N. M., to Midland; 37 miles of 8-in. and 10 miles of 6-in. between Big Spring and North Snyder and 113 miles of 10-in. from Lufkin to Mont Belvieu. The middle section of line is part of an old crude system which is being converted.

Consolidated Natural Gas Co. and Mississippi River Fuel Corp. started a $50-million, 5-year exploration program for gas in Louisiana. The joint undertaking is being carried out through Mississippi River Fuel's established exploration and producing organization.

Consolidated Natural also has committed $3 million for leasing and exploration offshore with Mississippi River Fuel and other firms. Consolidated Natural says the moves are designed to obtain additional controlled reserves and save money over the cost of purchasing gas. Gas would be transported to the company's system through existing lines, the company says, not through a new line which Consolidated Natural was reported to be planning.

Union Oil Co. has started moving crude from San Joaquin Valley to its Oleum refinery on San Francisco Bay through its new 225-mile, 12 and 16-in. pipeline. The $16-million line is California's longest crude pipeline. Initial capacity, with the originating Junction pump station, is 50,000 bbl. per day. When stations are added at Coalinga and Patterson in August, capacity will be 80,000 bbl. per day. Boosters at Panoche and Byron, planned eventually, will bring capacity to 100,000 bbl. daily.

Also for Pipeliners . . .

Underground gas storage capacity is passing the 2 trillion cubic foot mark and still growing strong (P. 88) . . . TIPRO accepts the Harris-O'Hara gas bill if changes it suggests are accepted (P. 94) . . . Meanwhile, in Washington the gas bill limps along. Its friends are lukewarm—its enemies not organized yet (P. 95) . . . Lone Star Gas has stirred up a battle in North Texas with a proposal to create one reservoir with a single set of rules from 81 gas fields in Jack and Wise counties. Producers opposing the move charge it is a part of Lone Star's fight to keep Natural Gas Pipeline from taking gas from Lone Star's territory (P. 96) . . . Preliminary studies indicate a new crude line out of Williston basin is feasible (P. 97) . . . Service Pipe Line Co. has purchased crude lines of Utah Oil Refining. Both are Indiana Standard subsidiaries (P. 99) . . . Longest pipeline shipment of butane ever reported may emerge from Phillips-Standard of Ohio deal (P. 103) . . . Transcontinental lets contract for offshore gas line (P. 105) . . . Another major pipeline system in the Middle East appears a sure thing by 1960 (P. 106).

PLUS THESE TECHNICAL FEATURES: A report on high-capacity positive-displacement meters (P. 108) . . . Automatic delivery of stock to bulk plants (P. 113) . . . How booster stations compare with looped lines on payout (P. 116) . . . and Pipeline Patrol's construction tables (P. 263).

KERMAC V-1 may set offshore-equipment trend. It's the . . .

First Stock-Model Barge Sold

ORANGE, Tex.—Increased drilling activity in Venezuela's Lake Maracaibo has prompted a big oilfield supply company to start building a series of drilling tenders for "in-stock" sale.

The first such tender, built for Continental-Emsco Co., was commissioned May 17 at Levingston Shipbuilding Co.'s yard here. It has been sold to Kerr-McGee Oil Industries, Inc., for operations on Lake Maracaibo.

Continental-Emsco officials said it is the first of many such vessels to be built for "in-stock" sale. The company already has ordered five tenders to be built and equipped before being sold to operators or drilling contractors.

The Kerr-McGee unit, named the "Kermac V-1," is part of a $2,500,000 package unit including rig and crew and work boats. Kerr-McGee has contracted it to Sun Oil Co. for drilling in Lake Maracaibo. The tender will tie up to a drilling platform and will provide all power to the draw works, mud pumps, and mud-mixing bins. The vessel is 180-ft. long, 70-ft. wide, and 11-ft., 3-in. deep. It is scheduled to leave Orange for towing to Venezuela about June 10.

Kerr-McGee has ordered a second tender from Continental-Emsco. It is scheduled to drill on a Lake Maracaibo concession recently acquired by a combine including Phillips Petroleum Co., Sunray Mid-Continent Oil Co., Ashland Oil & Refining Co., Western Natural Gas Co., El Paso Natural Gas Products Co., Kerr-McGee, Pacific Petroleums, Ltd., and Canadian Atlantic Oil Co., Ltd.

The second vessel is expected to leave for Venezuela about July 31.

Arrow Drilling Goes Abroad

TULSA.—Arrow Drilling Co. and Keir & Cawder, Ltd., of England have formed a drilling company to operate in the Middle and Far East, Europe, and Africa.

The new firm is Keir & Cawder Arrow Drilling Co., Ltd., with offices in Tulsa and Bishopbrigge, Glasgow, Scotland.

D. L. Edmiston, Arrow president, will head the new concern. Directors will be John P. Ohl and F. D. Murray, New York; William J. Stirling and George Wright, London; Hugh Macniven, Glasgow; and Edmiston. The company's drilling operations will be directed by Lloyd Hanson, Arrow's drilling superintendent. Equipment will be that now owned and operated by Arrow plus new rigs to be purchased to meet demands of the new operations.

Keir & Cawder is an established firm of consultants, designers, and manufacturers. It has handled big construction projects throughout the world. Arrow operates 21 drilling rigs in Oklahoma, Texas, Louisiana, and Arkansas. A Canadian branch operates seven rigs.

Refinery to Close

Texaco to leave Montana when new plant is opened

SUNBURST, Mont.—The Texas Co. is going to close its 8,000-bbl. refinery here in late 1958 or early 1959.

E. J. Scheibe, superintendent, said the shutdown will be effective when Texaco's 40,000-bbl. Puget Sound refinery at Anacortes, Wash., begins operation, probably in the first quarter of 1959.

He explained that on completion of the Anacortes works, changes in distribution and supply of products will eliminate the necessity of continuing the Sunburst refinery.

The 105 employes here have been notified by letter of plans to suspend operations. All employes hired before January 1, 1956, will be offered transfers to Anacortes or other company refineries.

Texaco reportedly is negotiating for sale of the Sunburst refinery. Scheibe declined comment on reported plans for disposition of the refinery, saying an announcement will be made by Texaco "in the near future."

Texaco acquired the refinery in 1928 and continued its operation under the name of International Refinery until 1940 when it adopted The Texas Co. identification.

The plant was established by L. B. and John O'Neil in 1924 as a topping plant, taking lighter fractions of crude by distillation and selling the tops to other plants. It had a capacity of 500 bbl. In 1926 capacity was increased to 1,200 bbl. In August of that year the O'Neils sold their interests to California Petroleum Co.

Another Tripod Ordered

TULSA.—Reading & Bates Offshore Drilling Co., a relative newcomer to offshore operations, is expanding in the Gulf of Mexico.

The firm has ordered a mobile, tripod drilling platform capable of drilling to 17,000 ft. in 90 ft. of water. Cost of the platform is about $2½ million. The company said it might do some drilling on its own after the unit goes into operation.

R. G. LeTourneau, Inc., will build the platform at its Vicksburg, Miss., yards. Work will start early in July. Delivery is set for March.

The platform will be the first of its type, but similar in basic design to other LeTourneau tripods. It will be 136 ft. long, 135 ft. wide, and have a maximum load capacity of 3,800,000 lb.

With option on Gulf lease:

C.A.T.C. Expanding Offshore

HOUSTON.—The C.A.T.C. Group has an option to acquire half interest in a 30,000-acre block of leases off the coast of Louisiana.

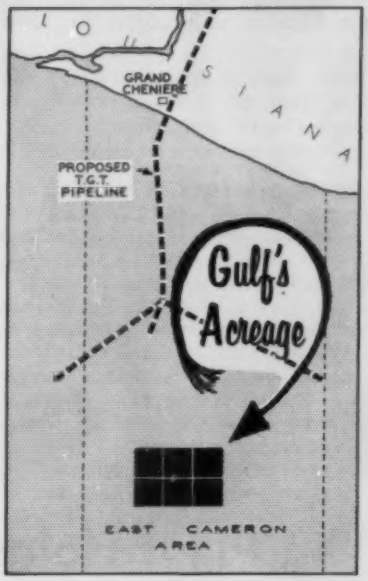
The leases cover six blocks of 5,000 acres each in the East Cameron area. Gulf Refining Co. paid the federal Government bonuses totaling more than $7,000,000 for the leases in 1954.

The acreage lies about 30 miles off the coast of Cameron Parish under water some 60 ft. deep. It comprises federal blocks 103, 104, 105, 114, 115, and 116. The tract is nearly 9 miles long and 6 miles wide.

Although Gulf paid more than $240 an acre in bonuses for the leases 2½ years ago, the company has done little drilling in the area. There are two dry holes there but no commercial production.

The northern edge of the block is only about 12 miles from a pipeline to be laid by Tennessee Gas Transmission Co. to other C.A.T.C. leases *(See page 93 and The Oil and Gas Journal, April 22, page 84).*

The C.A.T.C. Group includes Continental Oil Co., Atlantic Refining Co., Tidewater Oil Co., and Cities Service Production Co. They are among the most active companies in the tidelands.



The agreement between C.A.T.C. and Gulf was reached several weeks ago, but Gulf has withdrawn details pending signing of final papers. The deal reportedly involves a drilling commitment by which C.A.T.C. can earn up to 50 per cent interest in the leases.

From Texas to Ohio by pipeline:

. . . L.P.G. Set for Record Trip

CLEVELAND.—The trend toward increased pipeline movement of L.P.G. is underlined by a pending deal for shipments of butane more than 1,000 miles from the Texas Panhandle to Lima, Ohio.

Standard Oil Co. (Ohio) plans to purchase 400,000 bbl. of normal butane from Phillips Petroleum Co.'s Borger, Tex., refinery for seasonal blending to meet vapor-pressure requirements in motor fuel. The product will be moved in weekly 20,000-bbl. batches between October 1 and March 1.

This will be the longest pipeline movement of butane ever reported. The project will involve shipment through three pipeline systems.

Butane will be shipped in this manner:

. . . **Phillips will** move it through its products line to Wood River, Ill.

. . . **Ohio Oil Co. will take it** from there to Speedway, Ind., near Indianapolis, for tendering to Buckeye Pipe Line Co.

. . . **Buckeye will move** the product to a metering terminal at Lima, where Sohio will accept custody near its refinery.

Certain additions and changes in pipeline systems will have to be made to accomplish the complicated movement, which will interrupt the normal transportation pattern. Ohio will lay an 8-mile, 10-in. line to link with Buckeye at Speedway. Buckeye will increase pumping capacity from Speedway to Lima, and erect storage at Speedway. Sohio will build a 2-mile, 8-in. spur line from the metering terminal to its refinery.

A buffer of house-brand gasoline will be used to prevent product mixing in the line. As a result, Sohio will have considerable buffer material to dispose of at Lima. The gasoline will be wholesaled or processed at the refinery to Sohio specifications.

——Industry briefs

Plymouth Oil Co. is negotiating for concession rights in French West Africa and in Guatemala in the firm's first move off the North American continent.

Walter S. Hallanan, president, said the company is trying to tie down 3,000,000 acres on the Ivory Coast of Africa on a 50-50 basis with a French firm.

Plymouth Oil would be the sole holder of a 500,000 acre tract in Guatemala.

Phillips Petroleum Co. is seeking a permit from the Texas Railroad Commission to install and operate an automatic custody transfer system on its F. P. McCabe lease in Emperor field, West Texas. The Winkler County system would be one of the first to be operated in conjunction with a water flood. Phillips' McCabe lease has 14 producing wells, 12 water injection wells.

The L.A.C.T. unit would be Phillips' fourth. The company has one other in Texas and two in Oklahoma. The Emperor unit would be similar to the other three.

Standard Oil Co. (N. J.) and its British subsidiary, Esso Petroleum Co., have placed orders in Europe for six tankers. Jersey Standard ordered three 47,000-tonners from Verolme United Shipyards, Rotterdam. Esso Petroleum placed an order for three 47,400-tonners, two Vickers Armstrongs, and one with a Swedish yard. Esso has an option to increase the size to 65,000 tons.

Louisiana's oil-production allowable for June will be cut about 50,000 bbl. a day, Conservation Commissioner John B. Hussey forecast.

The announced cutback would drop the daily allowable to about 833,000 bbl., or some 157,000 bbl. below the peak of 990,642 bbl. last March when the oil lift to Europe was in full swing. The May allowable is 883,310 bbl. daily.

A pipe-laying barge designed for year-around operations in the open sea is under construction for Brown & Root, Inc. The $2,250,000 barge will be the largest vessel of its type ever built. It will be able to lay 36-in. pipe. Levingston Ship Building Corp. will build the unit at Orange, Tex. Delivery is expected by December. The barge will be 350 ft. long, 60 ft. wide, and about 22 ft. deep.

Proration in Texas?

With only a small cut in new allowable and stocks high and going higher, producers fear it will come in June

AUSTIN.—Crude stocks are piling up fast in Texas. And the build-up will continue into June.

Producers are afraid this means heavy pipeline proration next month. The lines already are prorating in some traditionally soft-market producing areas.

Texas stocks shot up by 6,800,000 bbl. during April. They will continue to climb about as rapidly in June as a result of action by the Texas Railroad Commission on the June allowable.

The commission set the June allowable at 3,434,618 bbl. daily. This is down 77,441 bbl. daily from the May 11 figure and 40,216 bbl. daily from May's initial allowable.

The decrease, however, was the smallest the commission could make. It amounted to a "hold the line" policy in view of the crude buyers' near-unanimous push for a deep cut.

Eight of 11 buyers pressed for 14 producing days (the commission settled on 15). This would have meant a 237,581-bbl. slash from May 11. Two buyers, Magnolia Petroleum Co. and Atlantic Refining Co., sought only 13 days, a cut of about 400,000 bbl. daily. Only Sun Oil Co. was on the high side, recommending an 82,687-bbl.-daily increase on a 16-day schedule.

June's 15-day schedule will leave Texas producing at a slightly higher rate than in October 1956, prior to the Suez crisis. A 14-day rate would have put the state under the October 1956 rate.

Independent producers for the most part opposed an allowable cut any larger than that made.

Sales dropping . . . Some purchasers, on the other hand, said they would be in bad shape on stocks if the allowable were set above 14 days.

D. R. Wall, crude buyer for Magnolia, said his company already has accumulated 15,800,000 bbl. of crude in storage as compared to a desired level of 14,000,000 bbl.

This, he said, is despite the fact that the company still is benefiting to some extent from sales generated by the Suez crisis. Magnolia's Suez-inspired demand, however, is down 38,000 bbl. daily and will decline another 17,000 bbl. in June to 49,700 bbl. daily, Wall said.

He said Magnolia has cut its refinery runs at Beaumont by 15,000 bbl. daily, but will still be going to storage next month unless a 13-day producing pattern is adopted.

Producers in jam . . . Producers selling to Crown Central Petroleum Co., meanwhile, were being slugged hard by the strike at Crown Central's Pasadena, Tex., refinery.

Midwest Oil Corp. said it has had to shut in 15 wells in the Running W (Waddell) field in Crane County because Crown Central couldn't take the oil. The oil is shipped to the Gulf Coast by Gulf Oil Corp. for Crown Central's account.

Midwest's Will Odom said no other buyer would take the oil and the wells would have produced only 6 days in May. He complained that the leases were being drained by an offsetting Gulf lease and asked that the field allowable be cut sharply to maintain ratable take. The commission took the request under advisement.

ALLOWABLE BY DISTRICTS

(Figures in barrels per day)

District—	June	Decrease from May 11
1—Southwest	71,613	960
2—Gulf Coast	152,986	4,423
3—Gulf Coast	482,478	9,323
4—Southwest	245,864	5,529
5—East Central	41,739	911
6—Outside E. Texas field	142,353	3,756
6—E. Texas field	203,149	5,836
7-B—N. Cent. Tex.	196,426	4,253
7-C—W. Cent. Tex.	193,995	4,954
8—West Texas	1,262,856	32,882
9—North Texas	306,592	4,239
10—Panhandle	134,567	375
Total	3,434,618	77,441

Big Plant Holds Open House

HOUSTON.—The petrochemical industry got a peek last week at its newest processing plant.

Texas Butadiene & Chemical Corp. opened its gates to the public for the first time during a 2-day preview and dedication ceremony at its new $30,000,000 plant. It was estimated that more than 600 persons inspected the sprawling facilities along the San Jacinto River near Houston.

The nation's first privately financed butadiene plant, the Texas Butadiene unit is expected to be the world's largest purchaser of liquefied petroleum gases for petrochemical manufacturing. It consumes nearly 600,000 gal. daily of ordinary commercial-grade butane, 180,000 gal. of isobutane, and 65,000 gal. of isopentane.

Double duty . . . Actually, the installation is the equivalent of two plants in one. In one unit, butadiene is made while in the other alkylate feed stock is produced for aviation-grade gasoline.

Both units are self-sufficient, but they are able to interchange byproducts. Primary feed stock of the alkylation unit is the butylene byproduct from the butadiene plant. Part of the primary feed stock for the butadiene plant comes from debutanizers in the alkylation plant.

At capacity operation the plant is designed to produce 64,800 tons annually of butadiene and about 2,500,000 bbl. of high-octane, aviation-grade gasoline. Under an alternate mode of operation, butadiene output can be increased to 86,000 tons.

In addition to plant-site storage, Texas Butadiene has underground storage for 1,500,000 bbl. of L.P.G. The underground storage is in a salt dome at Mont Belvieu, Tex. Some 63 miles of pipeline connect the plant with the storage area and with a terminal on the Houston Ship Channel.

The processing area of the plant is divided basically into these three segments:

. . . The dehydrogenation area. Using the Houdry process, it catalytically converts n-butane to butadiene and butylenes.

. . . The recovery area. Under license by Phillips Petroleum Co., it separates and recovers butadiene and butylene-containing streams. It uses furfural extractive distillation as well as conventional fractionation.

. . . The sulfuric acid alkylation area. Under joint license by Stratford Engineering Corp. and Texaco Development Corp., it charges fresh isobutane and butylene-containing streams from the recovery unit.

History of the plant dates back to 1954 when studies began to determine the economic feasibility of a privately financed installation. Plans for it were announced after the Armed Services Petroleum Purchasing Agency granted the company a "facility-expansion contract."

Fluor Corp. was commissioned to design and erect the plant. Construction started in the fall of 1955.

Lease Sale Planned

U.S. to put new Louisiana offshore areas on block

WASHINGTON.—Interior officials are planning to sell more leases on the outer Continental Shelf before the end of the year.

The department hopes a decision on Louisiana's boundary will be handed down by the Supreme Court before it quits for the summer early next month. But even if the case is not decided, Interior will go ahead with its plan under an agreement which Louisiana accepted last October *(The Oil and Gas Journal, October 15, 1956, page 84)*.

The department's new plan was disclosed in hearings before a Senate committee going into military withdrawals in the Gulf of Mexico. No date has been set for the sale, but the industry will shortly be invited to make nominations.

The main subject of committee study was a Navy withdrawal of Continental Shelf lands from which Interior officials said the Government could get more than $250 million in lease bonuses. The area runs about 50 miles south of the Louisiana coast. The Navy would like to double it.

Navy officials said they had given up two strips of the area closest to the coast at Interior's request. The rest is being held because there has been no move toward commercial exploitation.

Officials contended the Navy had a right to the area since it was set up legally before passage of the OCS Act. But Sen. Clinton Anderson of New Mexico pointed out that the act is now law and the Navy must abide by it "just like everyone else."

Transco to Tap Offshore Gas

HOUSTON.—Transcontinental Gas Pipe Line Corp. has let contract for construction of a 28.5-mile pipeline to move natural gas from a submerged field off Louisiana.

Contractors are Sharman, Allen, Gay & Taylor, Inc., Houston. The project is expected to be completed in about a month.

The 16-in. line will extend from Block 45, West Cameron area, to the existing Transco system near the Intracoastal Canal southwest of Vinton, La. About 7.5 miles of the route will be under the Gulf of Mexico.

Transco has contracted for gas reserves estimated at 88 billion cubic feet in Block 45 field.

Processing briefs

Pontiac Eastern Corp. will fire up the first boilers at its new refinery near here the first week in June.

About a month later, the catalytic cracking unit will go into operation. The 14,500-bbl. plant is expected to be fully on stream in September or October *(The Oil and Gas Journal, March 18, page 96)*.

The new refinery will process both heavy crude and field distillates. It will produce three grades of motor fuel in addition to kerosine, diesel fuel, coke, and sulfur.

James Duren, manager, said the refinery is designed for a gasoline yield of about 78 per cent.

Delaware's Gov. J. Caleb Boggs was one of the principal speakers last week at the dedication of Tidewater Oil Co.'s 130,000-bbl., $200-million refinery at Dalaware City. Others on the program were David T. Staples, Tidewater president; George F. Getty II, vice president; George C. Caine, eastern division manager of manufacturing; Sen. J. Allen Frear, Jr.; and Rep. H. G. Haskell, Jr.

Tidewater's Delaware plant boasts six record-size process units out of a total of 11 (see special section on page 159). It is capable of producing all of its gasoline in the 100-plus octane range. The company revealed it has also spent some $20 million at Avon, Calif., refinery recently and is studying tankers of more than 100,000 tons.

Foundations are being poured for a new 80,000-bbl. unit at The Texas Co.'s big Port Arthur, Tex., refinery. Next step will be installation of five vertical heaters and erection of the 165-ft. crude tower—one of the largest ever to be built. Fluor Corp., Ltd., has the contract.

The new still will replace existing units with a daily charge capacity of 60,000 bbl., resulting in a net increase of 20,000 bbl. per calendar day. The unit will increase the refinery's crude capacity to 250,000 bbl. per calendar day.

Dow Chemical Co. has started work on its petrochemicals plant at Bay City, Mich. Ethylene will be the chief product of the plant, which will draw raw materials from the nearby refinery of Bay Refining Corp., a Dow subsidiary. The plant is expected to go on stream in about a year. It will have cracking, ethylene, and butadiene units grouped around a central control house.

Ben Franklin Refining Co. of Ardmore, Okla., a subsidiary of Bell Oil & Gas Co., is adding a 1,000-bbl. alkylation unit at its 13,300-bbl. refinery. The unit, licensed by Universal Oil Products Co., will be built by Refinery Engineering Co.

A 7,000-bbl. catalytic cracker is nearing completion at the Port Credit, Ont., refinery of Regent Refining (Canada), Ltd. Procon (Canada), Ltd., is doing the work. Other facilities going in at the 14,000-bbl. plant are a gas concentration unit, polymerization plant, and gas treating and vacuum units. Procon is also expanding the crude unit.

Also for Refiners . . .

Crude-oil imports will pass the 1,000,000-bbl. daily mark this month and keep up the rate through the third quarter, Texas Railroad Commission reports. But any relief from the increased imports won't come from Washington before late summer (P. 85) . . . Sinclair has joined other majors in offering its employes a 6 per cent wage increase (P. 98) . . . The West Coast can't produce enough domestic oil and gas to meet its soaring needs now. The plight will grow much worse in the next 10 years (P. 100) . . . Texaco plans to close its Sunburst, Mont., refinery when its new 40,000-bbl. Anacortes, Wash., refinery goes on stream (P. 102) . . . Texas Butadiene & Chemical dedicates its new $3-million plant at Houston (P. 104) . . . Plans to develop Milford Haven into Europe's leading supertanker terminal may get rolling within 2 months (P. 106).

PLUS THESE TECHNICAL FEATURES: A special report on Tidewater Oil Co.'s ultramodern, 130,000-bbl. refinery at Delaware City (P. 159-198) . . . Refinery construction report (P. 132) . . . On the Job—In the Fields (P. 141) . . . Field Processing (P. 142) . . . The Foreman's Page (P. 153) . . . Questions on Technology (P. 155) . . . Refiner's Notebook (P. 157) . . . and PETROdatics (P. 158).

Suez Bypass Certain

● Some problems remain, but the big line looks like 38 or 40-in., with twin lines possible; it ultimately will handle almost 1½ million barrels of crude daily

A MAJOR pipeline system to move Middle East oil nearer European markets is going to be built by the early 1960's.

That much was certain last week as 17 oil companies with interests in the Middle East adjourned a second round of London conferences.

M. J. Rathbone, president of Standard Oil Co. (N. J.), told his stockholders last week that moving Middle East oil to European markets is going to be more important than it ever was.

"I have just returned from conferences in London where this project was discussed and I can tell you that, even in a business where very large-scale efforts are commonplace, the scope of this pipeline project is one of unusual magnitude."

Rathbone cited the project as an example that "in the oil business, plurality of effort is often essential to the accomplishment of necessary undertakings which no individual company can complete alone."

He said the pipeline, if it becomes a reality, will not only be a tribute to effective cooperation among many private companies and governments but it will add "an important element of flexibility to the pattern of world energy supply . . ."

Why line needed . . . Rathbone's company and another U. S. major revealed figures last week which point up the need for the mammoth pipeline project.

Jersey Standard predicts that by 1975 oil will supply 47 per cent of the world's total energy source. This means, Rathbone said, world oil consumption in 1975 will be about 32 million barrels a day, or more than double today's output.

Albert L. Nickerson, president of Socony Mobil Oil Co., Inc., put his firm's predictions in a little different way, but they still add up to much more oil, and most of it will have to come from the Middle East.

Nickerson said U. S. demand will rise more than 40 per cent by 1966 and more than 80 per cent in the remainder of the free world in the same period. Most of this 80 per cent increase will be in Western Europe which draws the major part of its oil from the Middle East.

Several questions, most of them pretty intricate, are still not fully settled. Here are some of them:

. . . Financing. Estimated cost of the system that has been discussed is more than $840 million.

. . . Ownership. This will probably go hand-in-hand with the financing once it is worked out.

Last week's London talks represented a broadening of interest in the line. The first such talks held were attended by the "big eight" international oil companies.

Last week nine more companies, all smaller American firms, joined in the 4-day meeting. The nine new companies are the owners of Iricon Agency, Ltd., which holds 5 per cent interest in the Iranian consortium.

. . . Route of the line. This will depend on the outcome of talks with the governments of countries to be crossed by the system. The route apparently favored by the companies is north from the head of the Persian Gulf into Turkey and west along southern Turkey to the Mediterranean.

The system could serve all the major Middlle East producing countries, Saudi Arabia, Kuwait, Iran, and Iraq, as well as the Neutral Zone.

The governments of all these producing countries would have to approve the plans as producers as well as transit nations. The same would be true of Turkey, which has indicated in the past that it would look with favor on the project.

. . . Size of the line. It will apparently be 38 or 40-in., with a good possibility of twin lines.

. . . Engineering details. These are still to be worked out. The preliminary plans call for building a system in two stages.

The first stage would have the capacity to move about 800,000 bbl. daily by the early 1960's. The second stage, to be completed later, would boost this to 1,400,000 bbl. daily. Such a system moving this much crude over about 1,500 miles would require from 10 to 12 pump stations.

. . . Pipe availability. This will be one of the big hurdles to cross. The size of the pipe presents problems apart from the shortage of the necessary steel.

American pipe mills would need several months of retooling to manufacture pipe of this size and the job would presumably be even more difficult for European pipe manufacturers.

New Giant Port May Rise Soon

PLANS to develop Milford Haven into Europe's leading supertanker terminal and repair center may get rolling within 2 months.

Parliament is expected to approve with little trouble projects proposed by three companies for the Welsh port. Unless unexpected opposition develops, the three bills—already in the final stages—will pass automatically without debate.

Esso Petroleum Co. and British Petroleum Co., Ltd., both could have work under way this year on projects almost within a stone's throw of each other.

Esso plans to build a 100,000-bbl.-daily refinery and a terminal capable of handling the largest foreseeable tonnage at a 1,000-acre site a mile west of town.

Official approval is still needed from Esso's parent, Standard Oil Co. (N. J.). But Esso already has contacted local contractors for bids, and work could begin in September. Cost would be about $56,000,000.

B.P. already has let contracts for some of the work on a tanker terminal on the south shore of the port, Popton Point. A 60-mile crude line to the company's Llandarcy refinery is part of the $14,000,000 program.

The third project is a plan by the local Milford Docks Co. to build a terminal and dry docks capable of handling 100,000-ton tankers. This development would cost about $25,000,000. Money for the facilities would be raised over the next 3 years.

The fishing village came into attention after the Suez crisis last year. The port is a natural harbor and one of the few places in Europe where a deep channel could be kept open with relatively little dredging expense *(The Oil and Gas Journal, September 24, 1956, page 102).*

Desert Find Reported

French apparently hit pay zone with 5-mile stepout from Hassi Messaoud; seven other wells testing desert area

A FIVE-MILE stepout north of the Hassi Messaoud discovery which has given the French great hopes for the Algerian desert has apparently encountered the productive sandstone updip.

Incomplete and sketchy reports from Paris last week indicate that Om 1, drilled by Cie. Francaise Petrole (Algerie), found the pay zone at about 10,725 ft.

The Hassi Messaoud discovery well located a 450-ft. thick sandstone pay at about 11,500 ft. The French say the well will yield from 1,800 to 2,500 bbl. daily of high-gravity, sulfur-free crude *(The Oil and Gas Journal, December 31, 1956, page 104, and February 18, 1957, page 118).*

No details of the second well were available last week, but early this month the test was reported drilling at 10,700 ft. in what was described as clay in a Triassic formation. This well was drilled by C.F.P. (A.) with a heavy-duty rig.

The discovery was made by Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie (SN Repal). A short time after the discovery the two companies, both controlled by the French Government, pooled resources for work on concessions which each holds in Algeria.

Other drilling . . . In addition to the Om 1, the two companies have seven other wells drilling in the central Algerian desert area where they hold extensive acreage.

Here are progress reports on the wells:

. . . Md 2, another stepout from the Hassi Messaoud test being drilled by SN Repal, is drilling below 8,800 ft. near L'Oued Mya.

. . . Md 3, located 4.5 kilometers (2.7 miles) northwest of Hassi Messaoud and about halfway between the discovery and the apparently successful stepout, is drilling below 8,000 ft. This hole is also being drilled by SN Repal.

About 120 miles to the northwest of this activity, three wells are under way on the Berraine concession which has had at least two good previous gas shows.

. . . Guerrara 1 is drilling below 11,000 ft. with no shows reported.

. . . Hassi R'Mel 2 is drilling below 6,900 ft. in chalky dolomite and is nearing the Triassic dolomite horizon in which Hassi R'Mel 1 encountered high gas pressure 8 miles to the east.

This test is being drilled with an Ideco H 25 rig borrowed by SN Repal from Societe Languedocienne de Forages Petroliers (S.L.F.P.). Drilling on Hassi R'Mel 1 was suspended when the rig ran into mechanical troubles after it encountered high-pressure gas with a small amount of condensate from 6,993 to 7,301 ft.

. . . Borj Nili 1, in the north part of the Berraine concession, is drilling below 3,600 ft. with an Ideal 800 rig loaned to SN Repal by S.L.F.P.

. . . Near Oued Rharbi, about 300 miles to the west of the Hassi Messaoud area, the Hassi Guern el Moor 1 drilled about 25 ft. into a lower Devonian sandstone at about 7,150 ft. and encountered salt water.

. . . Ae 2, 30 miles west of Ghardaia, C.F.P. (A.) was drilling below 5,500 ft. on the D'Erg-el-Anngueur concession in limestone.

Farmout Deal Made

Sun to drill on big block in Sinu area of Colombia

SUN OIL CO. last week took another step into foreign exploration when its Colombian subsidiary acquired half interest in concessions covering 750,000 acres.

Colombian Sun Oil Co., a wholly owned subsidiary, signed a contract for the interest with the original applicants on the acreage. They were Mobil Oil Co. de Colombia and International Petroleum (Col.), Ltd.

In return for the half interest, Sun will drill two 9,000-ft. wildcats. Pure Oil Co. of Colombia and United Carbon Co. will join Sun in the arrangement.

The eight concession blocks are in the Sinu area of northern Colombia. They are located in Loma Verde, La Ceiba, Santa Lucia, Arboletes, Nicocli, Martinica, Rio Mangle, and Caimar.

Colombian Sun made a similar arrangement 6 months ago when it obtained half interest in a 450,000-acre tract held by I. P. C. in return for drilling a 9,500-ft. wildcat.

Earl Wilson of Dallas will manage Sun's Colombian operation.

Colombian Sun was one of the foreign subsidiaries organized last year when Sun Oil formed its foreign operations department. At that time the company revealed its plans for exploration programs in Latin America, the Bahamas, and Pakistan *(The Oil and Gas Journal, November 26, 1956, page 65).*

Iran Studies Bill

Law would open country to oil hunt by private firms

A NEW oil law which would open Iran to private oil exploration has been presented to the country's parliament at Teheran.

The bill authorizes National Iranian Oil Co., the government oil agency, to act as agent and negotiator for Iran on terms of exploration concessions. It provides that foreign firms established in countries where Iranians could hunt for oil are eligible to receive concessions.

The bill doesn't include profit-sharing terms. Those would be left for N.I.O.C. to negotiate with individual companies. The southwestern Iranian area where the International Consortium operates is not affected by the proposed law.

Here are the general terms:

. . . A 9,653-sq.-mile limit is placed on each exploration or exploitation area.

. . . Exploration must begin within 4 years after a concession is granted and is void if no discovery is made within 12 years.

. . . Concessions run for 25 years after the first discovery and can be renewed three times for 5-year periods for a total of 40 years.

Jersey Expands in Peru

The Peruvian Government has given the green light to International Petroleum Co., Ltd., on the purchase of half interest in properties and concessions of Cia. Petrolera Lobitos.

Under the agreement, the Standard Oil Co. (N. J.) subsidiary will pay $18,000,000 for the acquisition. International also will take over operation of fields now operated by Lobitos and absorb Lobitos' field staff.

Lobitos' parent company, Lobitos Oilfields, Ltd., London, will put $8,000,000 back into the joint development program. It will limit its own operations in Peru to marketing.

International expects to spend $40,000,000 in field development on the joint acreage by the end of 1961. The 138,000-acre area is in the northern coastal region *(The Oil and Gas Journal, March 4, page 83).*

A look at

High-Capacity P.D. Meters

... and how they're improving measurement techniques in pipelining

By D. C. McKinley

AS the petroleum industry increases the volumes produced and processed, it naturally follows that both marine and pipeline transportation functions must increase flow and handling rates. This means not only larger ships, pipelines, and storage vessels but increased efficiency in their use.

One area of possible improved efficiency which is common to both modes of transportation lies in measurement technique. The industry, having realized that fast accurate measurements can do much to expedite cargo movements, has concentrated on this phase. The most logical approach seems, at present, to be high-rate in-line measurement which can be made on a continuous basis. the high-capacity positive-displacement meter is currently leading the field as the most likely equipment to fulfill the requirements and is to be the subject of this discussion.

This paper is intended to review the status of high-capacity positive-displacement meters as used for accurate measurement purposes in the petroleum industry. In order to focus attention and prevent thoughts from drifting into the subject of p.d. metering in general, it is suggested that for the purpose of this discussion we consider as high-capacity meters only those rated at 2,860 bbl. per hour (2,000 g.p.m.) or above. A future paper discussing meters based on other than positive-displacement principles might be of considerable interest to the industry, especially in light of recent developments which indicate competitive possibilities.

Author is with Interstate Oil Pipe Line Co., Shreveport, La. Paper presented at annual pipeline conference, A.P.I. Division of Transportation, Cleveland, May 6, 1957, under title "High-Capacity Positive-Displacement Meters."

Author's note: The information contained in this paper is in no way to be interpreted as an endorsement of the equipment by the author or his employer. A thorough investigation was made to determine all types of equipment that come within the scope of this paper, i.e., positive-displacement meters with maximum capacities in excess of 2,860 bbl. per hour. If there should be other types or makes of meters in this category, they are unknown to the author. The manufacturers' names have been used only to aid in describing the equipment and to prevent confusion in interpreting the information transmitted.

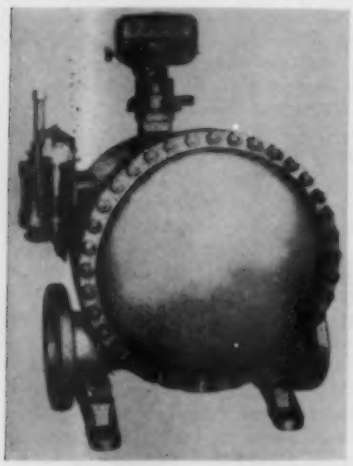
PIPELINING

It is assumed that the group for which this paper has been prepared is mainly interested in the general aspects of high-capacity meters such as accuracy, reliability, maintenance, and first cost. The details of design are therefore purposely neglected, it being logical that those interested in the fine points will prefer to obtain the data from the manufacturers.

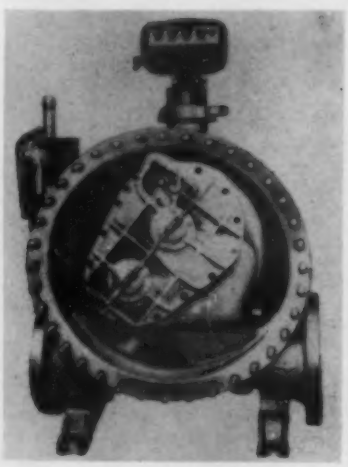
Commercially Available High-Capacity Meters

At this writing p.d. meters in the high-capacity classification are available in only two capacity ranges, from a limited number of suppliers. Considerable development is in progress and, although this discussion is mainly concerned with meters which are now commercially available or in the final development stage, others are expected to appear on the market momentarily.

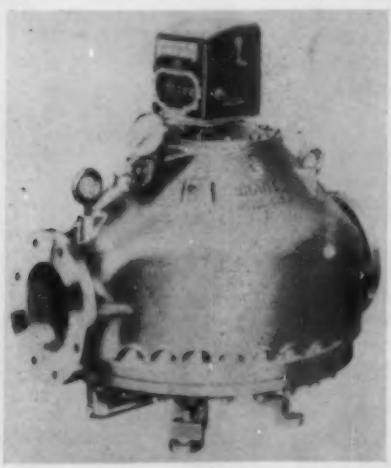
The available high-capacity meters can be grouped generally into the 2,800 and 10,000-bbl. per hour capacity classifications. Some users operate above manufacturers' rating; others operate slightly under ratings, but for this discussion these groupings are considered representative.



Brodie B-203 Meter. Fig. 1.



Brodie B-203—another view. Fig. 2.



Granco LM-8 meter. Fig. 3.

Smith B-200 meter. Fig. 4.

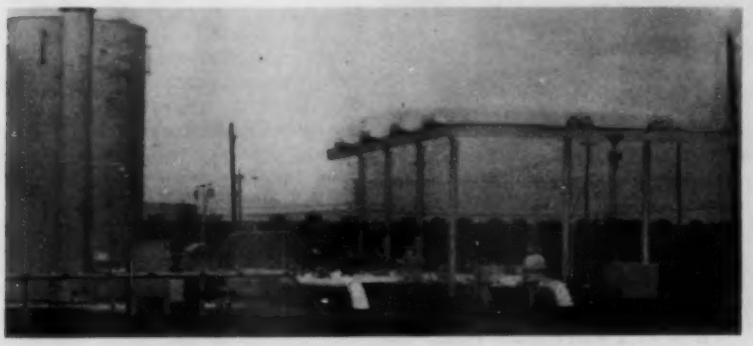
Smith B-200—another view. Fig. 5.

2,800 bbl. per hour — 150-psi. class . . . There are three types of meters available in the 2,800-bbl. per hour capacity, 150-psi. class which will be described, illustrated, and identified by manufacturers in Figs. 1 through 8.

In Table 1, meters in the 2,800-bbl. per hour class have been listed by type, approximate industry price, and capacity rating. Since most manufacturers consider it sound practice to overload their meters for intermittent short periods of time, the table includes the capacities at 10 per cent above manufacturers' continuous-operating ratings.

TABLE 1—P.D. METERS, 2,800 BBL. PER HOUR, 150-PSI. CLASS

Manufacturer and type—	Approximate price	Ratings, bbl. per hour— Manufacturer continuous	10 per cent over
Brodie B-203	$3,000	3,000	3,300
Granco LM-8	2,025	2,860	3,150
Smith B-200	3,011	2,860	3,150



Smith B-200 in complete installation. Fig. 6.

Smith B-700 meter. Fig. 7.

Smith B-700—another view. Fig. 8.

The approximate prices shown in Table 1 are based on list prices of the 150-psi. class, less the usual industry discount. Pressure ratings up to 1,000 psi. are available at higher prices which are comparable among the various types of meters and are omitted here for simplification. The prices in the tabulation represent the cost of the 150-psi. meters with only indicating registers. Cost of temperature compensation, printers, and other auxiliary items would raise the prices slightly. For comparative purposes, however, the tabulation as shown is considered adequate.

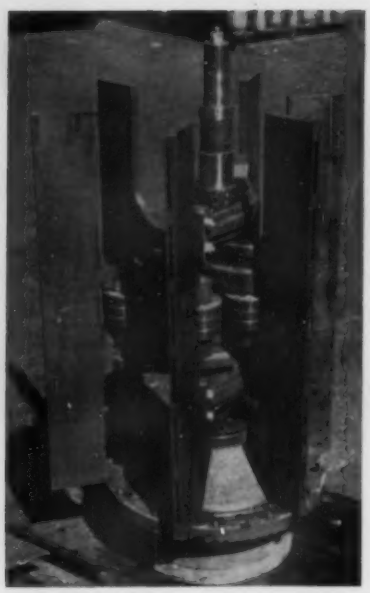
● **Brodie B-203.** The Brodie B-203 is a double-case meter using the helical birotor principle of positive displacement. It features a continuous rotating motion with no reversing action. It has a steel case equipped with 8-in. flanges; the face-to-face dimension is 32 in. Its estimated weight is 850 lb. Figs. 1 and 2 show the physical appearance of the meter. It was originally designed as self-lubricating but can be supplied with sealed bearings running in oil. The lubricating system was modified to increase the rating of the meter.

● **Granco LM-8.** The Granco LM-8 is a single-case meter using the rotary principle of positive displacement. It also features continuous motion and is self-lubricating. It has a steel case equipped with 8-in. flanges, face-to-face dimension is 35 in., over-all height is approximately 30 in. Its estimated weight is 1,200 lb. Fig. 3 illustrates the physical appearance of this meter.

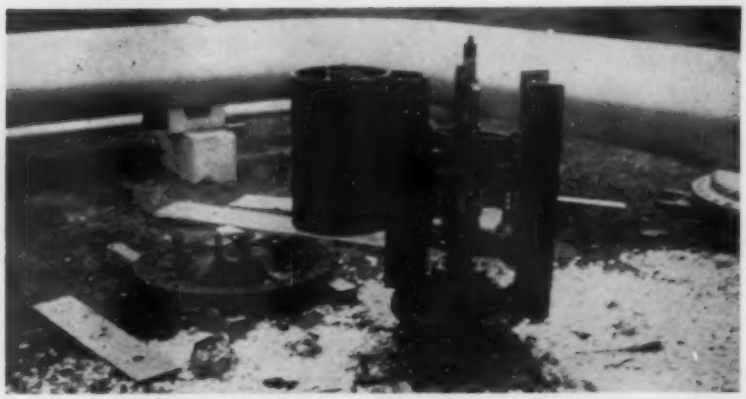
● **Smith B-200.** The Smith B-200 is a double-case meter using the rotary-vane principle of positive displacement. It employs a cam-controlled vane-type rotating element which is carried on self-lubricated bearings. The principle of operation requires reversing action for each revolution but permits smooth continuous-flow characteristics with low head loss across the meter. It has a 24-in. steel case with 10-in. flanges, face-to-face diamensions is approximately 31 in., over-all height is approximately 48 in. Its estimated weight is 2,000 lb. Figs. 4, 5, and 6 show the physical appearance of the meter.

Meters in the 2,800-bbl. per hour capacity range have been in operation for approximately 4 years. They have performed accurately, reliably, and economically. They have received favorable acceptance in both product and crude-oil service. Experience to date indicates a service life in the range of 20,000,000-bbl. throughput can be expected. The use of this

Smith B-700—inner case. Fig. 9.



Smith B-700—blade assembly. Fig. 11.



Smith B-700—internal mechanism. Fig. 10.

high-capacity meter has necessitated some changes in meter-operation and calibration practices which will be discussed later in this paper.

10,000 bbl. per hour—150-psi. class

At present there are only two types of p.d. meters developed in the 10,000-bbl. per hour capacity range; one has been delivered and tested and the other is under test. These meters are described in Table 2 and illustrated in Figs. 7 through 11 and identified by manufacturers. Table 2 is a tabulation showing comparative information on the two types of meters in this range. To date, they have been manufactured only in the 150-psi. pressure class.

Although these meters have not as yet been used in actual operations, the completed test on the Smith B-700 under similated operating conditions definitely indicates it to be satisfactory for industry use.

The prices shown are approximate for the 150-psi. class meters with indicating registers only; auxiliary equipment is available as desired.

● **Rockwell Multi-Meter.** The Rockwell Multi-Meter is an eight-element meter based on the roto-cycle principle. The individual elements are mounted on a common chamber in a manner such that they operate in parallel allowing the measured stream to divide equally between them. The throughput of each element is indicated at the element and fed into a combined figure for the total throughput. The design is such that the meter factor will be a combined factor for all the units.

The construction permits any element to be inspected individually providing the meter is out of service. The meter is equipped with 16-in. flanges with a face-to-face dimension of 104 in. It has an over-all height of approximately 50 in. and a width of 62 in. Its estimated weight is 7,100 lb.

Pictures and illustrations are not available at this writing.

● **Smith B-700.** The Smith B-700 is a double-case meter using the rotary-vane principle. It is essentially an enlarged version of the B-200 meter except it has six blades instead of four.

It has a 36-in. steel outer case with 16-in. flanges, face-to-face dimension is 46 in., over-all height is 65 in. The meter weighs approximately 5,800 lb. Figs. 7, 8, 9, 10, and 11 show the physical features of the meter.

This meter has been under field test for approximately 6 months and has measured over 30,000,000 bbl. of crude oil at rates near its maximum rating. An inspection made at 15,000,000 bbl. revealed that clearances were essentially the same as originally set. After inspection, the meter was reassembled with the same parts and placed back on the stream. The strainer protection for this meter is shop made from steel plate with ¼-in. diameter holes.

A complete set of performance data which has been obtained on two grades of crude oil will be given later in this paper.

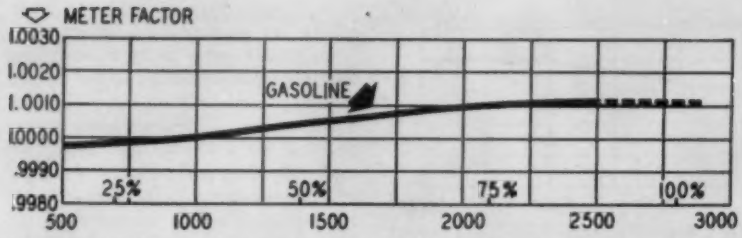
Performance

In general, the performance of high-capacity meters has been gratifying. The accuracy curves plotted from available field tests confirm that the manufacturers' designs are sound. Sufficient field data to assure acceptable accuracy have been collected on the 2,800-bbl. per hour class meters in both crude-oil and product service. At this writing, data on the 10,000-bbl. per hour class are limited to one meter measuring two grades of crude oil. The performance of each type meter is portrayed by characteristic curves shown on Figs. 12 through 20. The accuracy curves have been plotted in terms of meter factor versus flow rates on a scale purposely enlarged to aid in portraying the meter performance. All performance curves for each class meter are plotted on the same scale to assist in making visual comparisons.

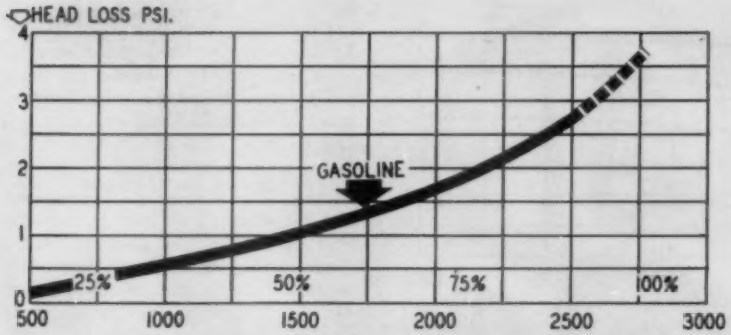
The head-loss curves are plotted in

TABLE 2—P.D. METERS, 10,000 BBL. PER HOUR, 150-PSI. CLASS

Manufacturer and type—	Approximate price	Ratings, bbl. per hour— Manufacturer continuous	10 per cent over
Rockwell	$14,000	10,000	11,000
Smith B-700	24,000	10,000	11,000



METER FACTOR vs. flow rate for Granco LM-8, 2,800 bbl. per hour, manufacturer's data. Fig. 12.



HEAD LOSS vs. flow rate, Granco LM-8, 2,800 bbl. per hour, manufacturer's data. Fig. 13.

loss psi., versus flow rates and are also on the same scale for all meters in the same classification for comparative purposes.

2,800-bbl. per hour class . . . Since the curves are self explanatory, it is considered appropriate to simply refer to the graph for each meter. It will be noted that in some instances only manufacturers' data are available and in such cases this information will be displayed on the charts. The fluid characteristics or identification is indicated for each curve.

- **Granco LM-8.** The performance data for this type meter were supplied by the manufacturer and are shown on Figs. 12 and 13.
- **Brodie B-203.** The performance data for this type meter were supplied from field test and are shown for three grades of product.
- **Smith B-200.** Performance data for this type meter were supplied from field test on both crude oil and product.

10,000-bbl. per hour class . . . Performance data for this type meter are available for only the Smith B-700 meter and were obtained from field test as shown in Figs. 19 and 20.

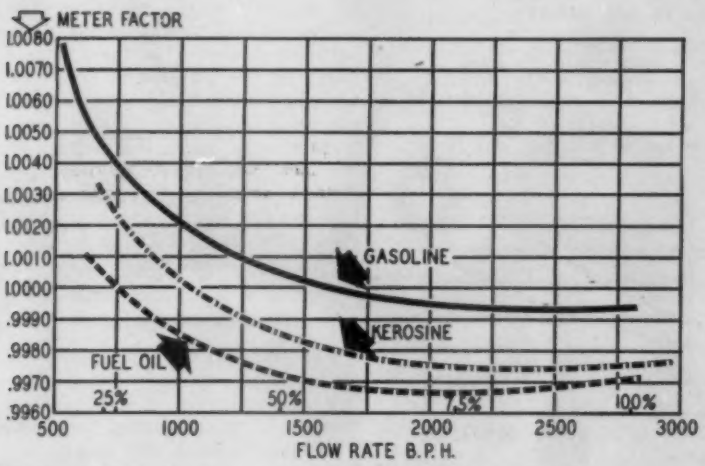
From these charts it is logical to believe that the accuracy performance for high-capacity meters may be expected to be more desirable than performance of smaller meters. The viscosity effect of crude oil tends to smooth out the performance and increase the head loss as is to be expected.

Operation, Calibration and Maintenance

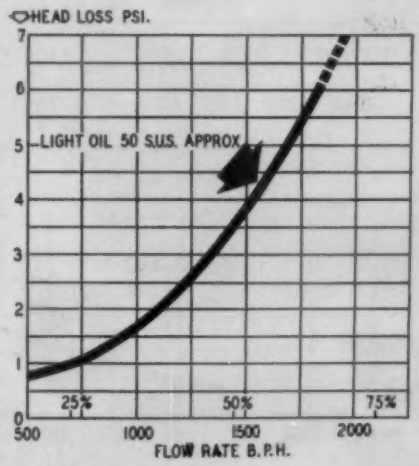
Operation . . . The operation of high-capacity meters is very much the same as for the smaller meters. The larger piping and valves required are compatible with the increased flow rates and are not a serious handicap to operations. It seems probable that some motor-operated valving is justified, especially for the 10,000-bbl. per hour class.

Calibration . . . Calibration equipment and procedure for the higher-capacity meters are of considerable concern and are receiving just consideration. In fact, a paper on the subject was presented before this group in 1954 and it is my understanding that it will be reviewed again at the annual A.S.M.E. conference this year. In view of this fact and the time element required to discuss the subject of calibration, it is deemed advisable here only to mention some of the systems which are now being successfully used. They are:

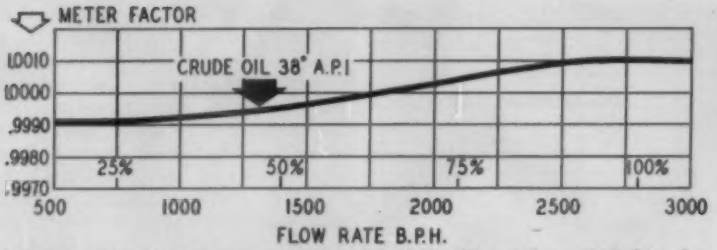
1. Calibrated line section with electrical connections to control counters.
2. Gravimetric proving with a 70-bbl. tank and appropriate scales.
3. Volumetric proving employing a 300-bbl. tank with a fixed volume



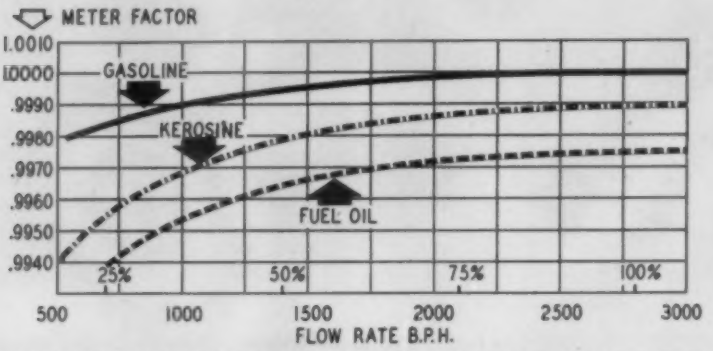
METER FACTOR vs. flow rate, Brodie B-203 modified, 2,800 bbl. per hour, field data, August 1956. Fig. 14.



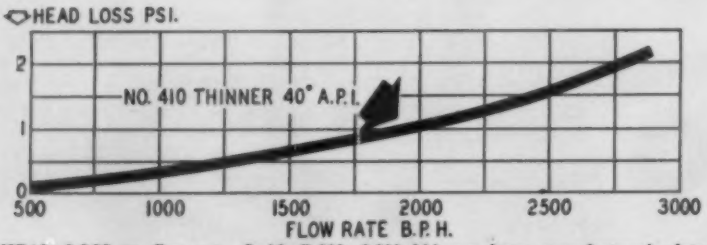
HEAD LOSS vs. flow rate, Brodie B-203, manufacturer's data. Fig. 15.



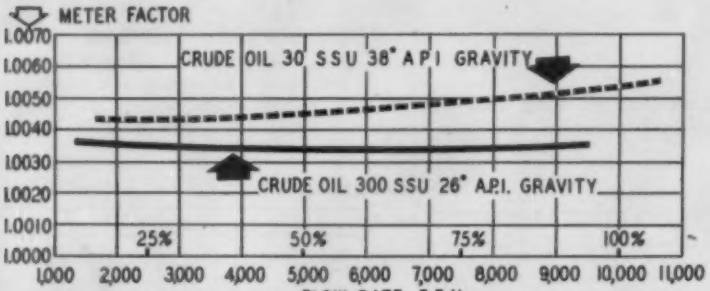
METER FACTOR vs. flow rate, Smith B-200, 2,800 bbl. per hour, field data, September 1954. Fig. 16.



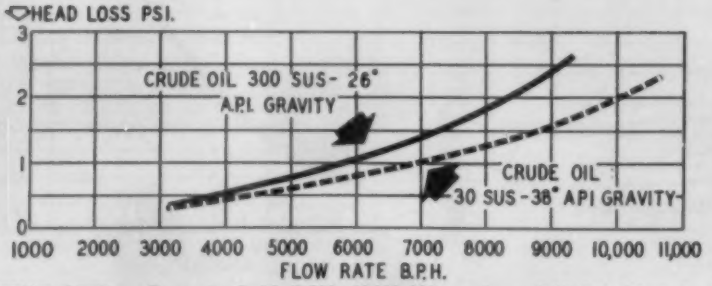
METER FACTOR vs. flow rate, Smith B-200, 2,800 bbl. per hour, field data, August 1956. Fig. 17.



HEAD LOSS vs. flow rate, Smith B-200, 2,800 bbl. per hour, manufacturer's data, October 1953. Fig. 18.



METER FACTOR vs. flow rate, Smith B-700, 10,000 bbl. per hour, field data, November 1956. Fig. 19.



HEAD LOSS vs. flow rate, Smith B-700, 10,000 bbl. per hour, field data, November 1956. Fig. 20.

, between weir lips and a reduced cross-section for reading the final volume.

4. Master-meter method employing multiple smaller meters as the master.

Maintenance . . . Maintenance experience on the 2,800-bbl. per hour class meters to date indicates a throughput of approximately 20,000,000 bbl. can be expected before major overhaul. This figure varies some, according to product and operating speeds, but is thought to be fairly reliable. An estimated parts cost for a major overhaul on this type meter is $120.

Experience does not afford a reliable estimate on throughput expectations on the 10,000-bbl. per hour class meter. Based on inspections to date, however, a long service life is anticipated.

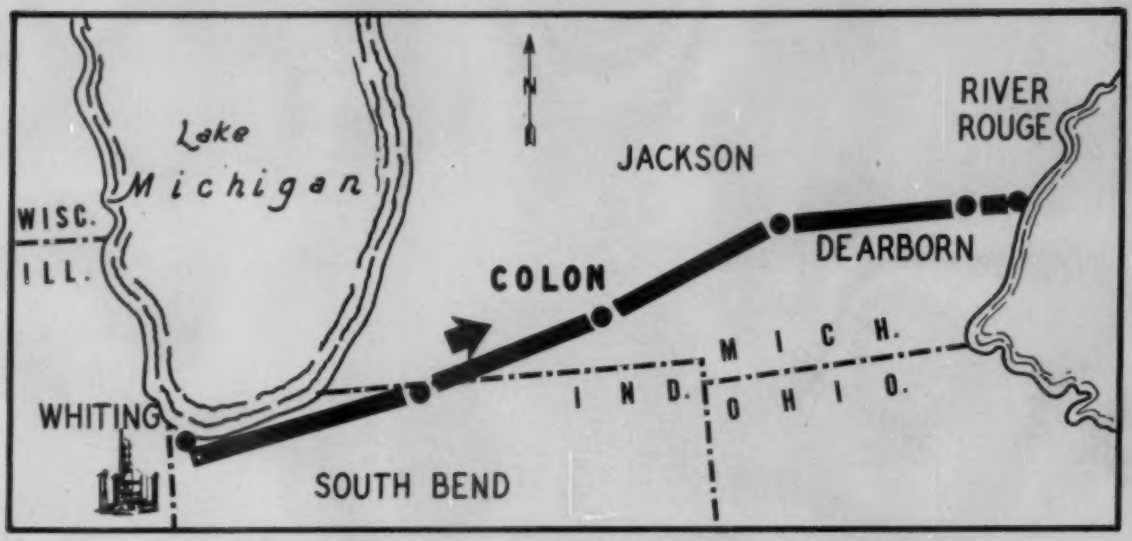
Future Development

For pipelines . . . There is considerable opinion in the industry that a meter in the 5,000-bbl. per hour range would be highly desirable for pipeline use. These opinions are based on the fact that rates in the 4,000-to-10,000-bbl. per hour range are quite common among pipelines and are in between rates as far as the present-day high-capacity meters are concerned. The 10,000-bbl. per hour meters have flexibility limitations and cost disadvantage while the 2,800-bbl. per hour class is too small. There are other considerations, of course, depending on individual circumstances. But the idea of a 5,000-bbl. per hour meter for pipeline use has enough support to merit some thought on the part of industry and manufacturers.

For terminals . . . A review of present and forecast marine-terminal transfer rates has also created some interest in a meter larger than the 10,000-bbl. per hour class. For example, a 40,000-bbl. per hour transfer rate seems to be a common goal among marine transportation interests. For these rates a meter in the 20,000-bbl. per hour range installed in banks of three would provide a flexible system with standby provisions. Again, this may not be the ideal size for the purpose and certainly would not be perfect for all high-capacity marine terminals; however, some industry collective thinking on this subject might be well rewarded.

Acknowledgment

The preparation of this paper was made possible through the cooperation and assistance of numerous industry and manufacturing personnel. Their contributions and interest deserves industry's acknowledgment and my sincere appreciation.



COLON BULK PLANT is midway on the 10-in. Whiting-River Rouge line. Fig. 1.

Standard enters unattended pipeline delivery as . . .

Bulk Plants Receive Stocks Automatically

by W. D. Lomax and H. W. Wilker

THE competitive nature of the oil industry has led all companies to search their pattern of operations for new savings. Each hopes to find new ways and means of bringing to its consuming public high-quality products at the lowest possible costs. The field of transportation has always been alert to new methods, and many of these methods have yielded suvstantial savings. Since entering the field of automation and unattended pipeline facilities, Standard Oil Co. (Ind.), has envisioned remotely controlled delivery of pipeline stock to bulk plants.

Location of control devices . . . The plant at Colon, Mich., was selected for the installation of control devices remotely started from the Chicago office. It was thought that this plant was representative of a typical bulk plant. Furthermore, it was within reasonable distance of a main line. Geographically, this plant is located at the midpoint of Standard's Whiting-River Rouge line and approximately 46 miles downstream of the South Bend pumping station. (See Fig. 1).

Authors are with Standard Oil Co. (Ind.), Chicago. Paper presented at annual pipeline conference of A.P.I. Division of Transportation, Cleveland, May 8, under the original title, "Unattended Pipeline Deliveries to a Bulk Plant."

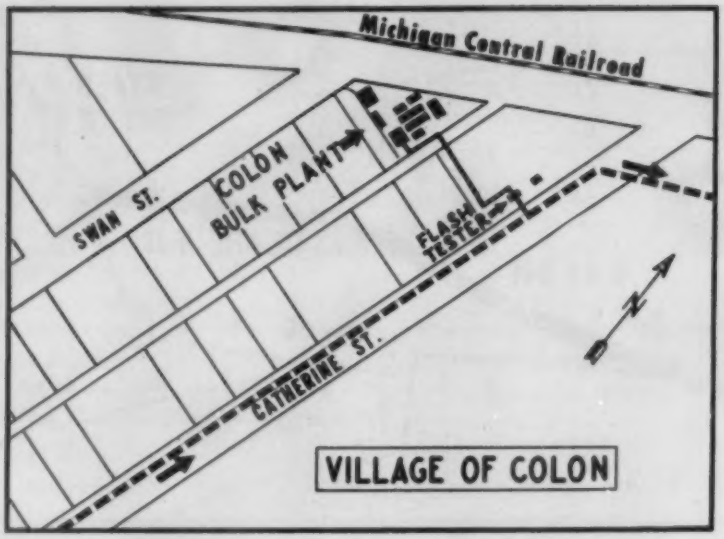
The 10-in. main line was routed in 1953 during construction through Colon, utilizing street right-of-way. (Fig. 2). This routing later necessitated that the line either be rerouted across the plant site or that laterals be installed to the plant. It was decided to tap the main line in the street and lay two laterals. Again, consideration was given to this being typical of connections which might be expected at bulk plants. It necessarily complicated the design.

Design requirements . . . The primary differences between unattended pipeline deliveries to bulk plants and terminals were soon recognized. The terminal-receiving facility design which Standard had successfully used at Lafayette, Ind., would not be applicable at Colon. Foremost, in design considerations, was the fact that once the product was delivered to the bulk plant, it was beyond the point of detailed testing. This is of particular importance in the handling of heating oils.

Secondly, since the delivery was made to a commission agent, the delivery should not increase his labors, but rather reduce them. Thirdly, the delivery from the main line, flowing at pressures as high as 1,000 psi., to the extremely small tankage should be accomplished at a slow rate. The flow should be accurately metered and recorded. There could be no outage to sumps or spill tanks. Furthermore, due to the location of the plant the operation must be extremely safe and reliable.

Piping . . . Small-diameter pipe was purposely used in the laterals to expend as much main-line pressure as possible before reaching the meters. The piping arrangement for the oil lateral is shown in Fig. 3. Product enters the oil lateral through a main-line tap at valve A. This valve is below grade and maintained in a normally open position. Valves B and C are an electrically operated solenoid and a motorized gate valve, respectively. These valves cannot be opened until the stock intended for delivery has passed through the flash tester and checked satisfactorily for delivery.

The dormant stock lying between



LATERALS were installed to connect the bulk plant. Fig. 2.

Design Features . . .

1. Once the product is delivered to the plant, it is beyond the point of detailed testing.

2. Delivery should not increase the agent's duties.

3. Delivery should be slow. Flow should be metered and recorded.

the solenoid valve and the main line could contain a mixture of gasoline and oil; therefore, a purge pump is used to displace this stock to the main line. Both the purge pump and flash tester are placed in operation upon receipt of a remote code signal initiated by the pipeline dispatcher. When the product tests satisfactorily for delivery, the flash tester initiates a signal to open both the solenoid and motorized gate valve.

The flow of product to tankage is not established until valve E is placed in the operating position. This valve is a diaphragm-operated globe valve controlled through a solenoid pilot. Valve D is a back-pressure regulating valve. With valves B and C open and valve E closed, valve D senses an increase in pressure and moves to the closed position. This affords a high degree of meter protection when valve E is opened. Upon receipt of a second remote code signal, valve E opens, establishing flow through the meters.

This plant was sized to receive at a rate of 140 g.p.m. Flow of product is limited by a flow controller placed immediately downstream from the meter. Restriction by the flow controller increases the pressure on the diaphragm of the regulating valve D, thereby restricting flow to the desired quantity.

Metering equipment . . . The metering equipment in this installation consists of: meter, meter switch, set stop, totalizer, ticket printer, and flow-rate controller. It should be noted that a set-stop valve was not used. The set-stop mechanism is used to preset the quantity of the desired delivery and to mechanically actuate the meter switch upon completion of the delivery. Meter proving is accomplished by connecting a portable master meter in series with the plant meter. The master meter is calibrated and tested at a main-line terminal against a 15-bbl. proving tank either in oil or gasoline, dependent on its intended use at Colon.

Control . . . The establishment of safe and reliable control of the operating devices at this plant necessitated a number of control circuits. Considerable thought was given to these devices and to their functions, and it was concluded that it would be necessary to safeguard:

. . . The minimum flash of oils.
. . . Against power failure.
. . . Against excessive meter pressure.
. . . Against tank overflow.
. . . Against false control signals.

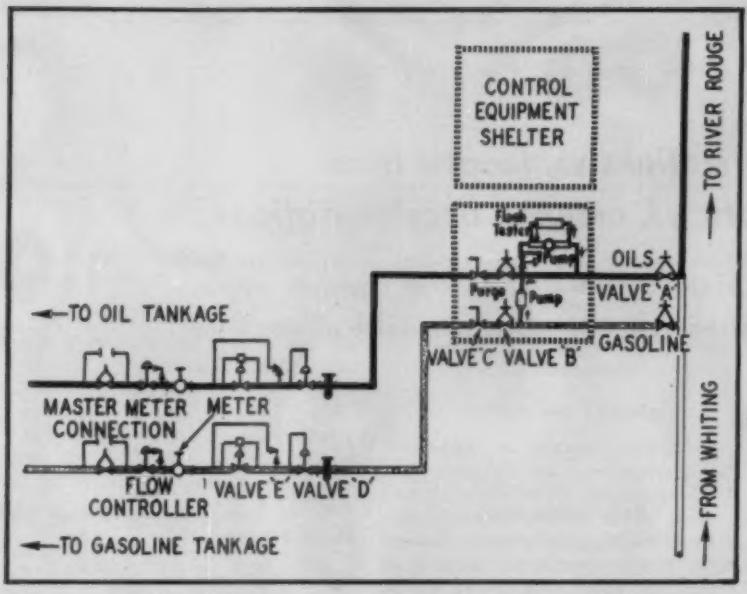
The operating devices incorporated in this design can be controlled by remote, local, or emergency signals. The success of the system depends upon these operating devices and their reliability.

Flash tester . . . The importance of the flash tester should not be minimized. Its function would be to test all product entering the plant through the oil lateral. It was recognized that flash testers used for other applications would not be suitable at this location; therefore, a new instrument of special design would be required. The instrument used was engineered and assembled by Standard's engineering research department at Whiting, Ind. It is basically a "go or no go" instrument. The instrument can be set for a specific flash point. Below that point, product is flashed and the plant is isolated from the main line. Above that point, the product is recognized as oil and admitted to the plant. The great dependency placed on this instrument necessitated that it be self-checking; spark ignition, fuel-air ratio, product flow, and product temperature are properly checked.

In this installation the elapsed time from the moment the test sample is drawn until the sample is actually tested is very critical. To minimize this elapsed time, very short runs of extremely small tubing were used. One of the more difficult tasks was in providing the flash tester with an appropriate sample prior to the establishment of flow in the oil lateral. This was accomplished by installing a purge pump. It was necessary that this pump operate with high static pressures and practically no differential head. Several different pumps and piping arrangements were tried before a satisfactory one was found.

Samples are supplied to the flash tester by an injection-type pump which delivers constant volume to the tester. Through a separate cylinder the injection pump returns drainage from the flash instrument to the line. This piping arrangement was used to eliminate the need for a sump.

Power . . . Experience in the operation of electrically powered devices has indicated good reliability; however, there have been power outages where neither motorized valves nor communications would function. A power outage at this location could not be tolerated. Since it could not be



SCHEMATIC of the unattended receiving facilities. Fig. 3.

controlled, attention was directed to controlling the effects which would result from a power outage. For that reason installation was made of solenoid pilot-operated valves which would automatically close should a power failure occur.

Under normal conditions with power available, the plant delivery is terminated by the set stop mechanically activating the meter switch. The motorized gate closes and upon reaching a closed limit, deenergizes the solenoid valves resulting in their immediate closure.

Tank-level switches were used to prevent the overfilling of any tank. These switches are electrically connected in series in the shutdown circuit with a high-meter-pressure mercoid, the flash tester fault switch, and an emergency station stop switch. Activation of any switch in the shutdown circuit causes the solenoid valves to close, followed by a closure of the motorized gate valve. False remote signals are prevented through the use of an access code which must be actuated before a function code can be operated.

Plant operation . . . In actual operation the plant agent gages his tanks and computes the desired delivery. This information is transmitted to the pipeline dispatcher who determines the availability of stock. After the agent is advised that his request for delivery has been approved, he (1) aligns the proper tank valves, (2) sets the delivery quantity on the meter set stop, and (3) inserts a ticket in the ticket printer. No further action or the presence of the agent is required during the stock delivery.

The pipeline dispatcher determines by calculated line fill when the heart-cut delivery is available. He then initiates a code signal to gain access to the plant control devices. This signal is followed by a second signal which starts both the purge pump and the flash tester in operation. Within a specific period of elapsed time he must initiate a third code signal to open the solenoid piloted valve. With the opening of this valve, delivery begins. The dispatcher can monitor the position of the motorized gate valve at any time. When delivery is complete the set stop opens the meter switch. The meter switch initiates action to isolate the delivery facilities from the main line.

The plant agent at his convenience and prior to subsequent deliveries removes the ticket from the ticket printer. This ticket is mailed to the accounting office and used for billing purposes.

Conclusion . . . In conclusion, we report that this experiment has proven successful. The immediate objective, that of collecting data from the operation of unattended pipeline delivery facilities at a bulk plant, has been accomplished. This data must now be analyzed and evaluated for future applications. We will carefully look at these apparent advantages which unattended pipeline deliveries have over rail or truck deliveries:

There is a reduction of paper work in preparing and processing stock orders and follow-up correspondence.

There is a reduction in the number of barrel-miles hauled where stock is backshipped from line terminals.

There is a reduction in vapor losses where stock enters terminal storage before shipment to the bulk plant.

There can be a decremental reduction in terminal tankage.

Manpower hours required to load truck or tank cars are eliminated.

Manpower hours required to unload tank cars are eliminated.

Demurrage charges on tank cars are eliminated.

Savings accrue through expansion of the agent's territory and increased sales.

Pipeline deliveries are not sensitive to weather and road conditions.

Unattended pipeline deliveries also have disadvantages. Those most apparent are:

The investment for the control devices is relatively high.

The control devices increase the pipeline maintenance costs.

There is an incremental increase in the dispatcher's work.

A preliminary analysis of the data does not indicate a widespread use of this type operation insofar as Standard's existing lines or plants are concerned. This is principally due to the economic disadvantage of investment required for laterals between the main line and plant. It does open up the possibility of use where existing plants have reached a state of obsolescence or where the density of plants indicates a favorable consolidation in one plant. Its usage in future plants and future lines will be weighed carefully. **End.**

Successful Experiment . . .

"The immediate objective, that of collecting data from the operation of unattended pipeline delivery facilities at a bulk plant, has been accomplished . . . there is a reduction of paper work in preparing and processing stock orders and followup correspondence."

Payouts . . .

. . . Booster stations vs. looped lines
. . . Automatic vs. manned booster stations

● Advantage of one system over another depends on per cent capacity increase, station spacing, and size of loop lines

By N. B. Mavris

THE past few years have seen a continuing increase in the use of automatic and remotely controlled booster stations. Communications improvement, supervisory-equipment development, and reliable safety shutdown devices have all combined to permit greater use of this type of station. Undoubtedly the use of automatic stations has been adequately justified economically. This article attempts to evaluate the use of these stations and present in graphic comparisons the effects of automatic operation of a booster station with a manned operation or with the use of a loop line.

Capacity increases on existing systems can be achieved by one of three methods, with automatic operation creating two subdivisions under the use of intermediate booster stations:

Intermediate booster stations (with either automatic operation or manned operation).

Looping with the same-size line or larger line.

Replacement with a larger-size line.

The comparisons made in this article are an attempt to generalize the solutions of the payout of a loop line vs. booster stations, both automatic and manned, and to compare the automatic and manned stations. It is hoped the solutions will be within the range of actual situations sufficiently that the solutions presented will serve as a guide to practical problems. While the assumptions should be accurate enough to be of value in judging loops vs. boosters, they are not expected to be a means of absolute selection.

Author is with Continental Pipe Line Co., Ponca City, Okla. Paper presented at annual pipeline conference, A.P.I. Division of Transportation, Cleveland, May 6, 1957, under title, "Effects of Automation —Loops vs. Boosters."

Basic Assumptions

In establishing the problem, several basic assumptions were made. It is hoped that these assumptions will be general and follow the majority of actual cases.

1. Stations equipped with electric motor and centrifugal pumps.

Due to the increasing use of this type of equipment in trunk-line stations in recent years, this assumption has been used in this study.

2. Maximum station pressure of 1,200 psi.

While there is some indication that newer lines are using higher pumping pressures, it is felt that a pressure of 1,200 psi. is more representative of pressures in use on existing systems.

3. Pump-unit capacities based on 50 per cent and 100 per cent increase volume.

For capacity increases between 0 and 50 per cent, the pumps selected were assumed to be capable of transporting a maximum volume of 50 per cent increase.

For capacity increases between 50 and 100 per cent, the pumps were assumed to be capable of transporting a maximum of the 100 per cent increased volume. Units would be added in series to reach the maximum pressure and volume required.

4. Intermediate stations on 24-hour operation.

Above the 20 per cent increase in volume, it was assumed the intermediate stations would operate full time, but at a reduced pressure. This assumption is in keeping with assumption No. 3 in which units will be added in series to reach the desired pressure and volume.

5. An existing communication with channel space.

Investment for channelizing equipment is included as well as maintenance costs on communication and supervisory equipment.

6. New pipe used for loop lines.

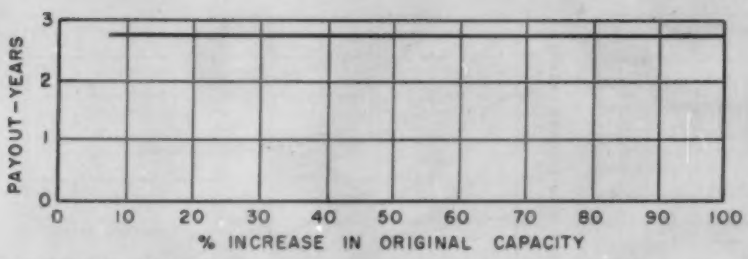
While actual situations could involve the use of second-hand pipe or other grades of pipe, it is felt that new pipe is used widely enough to justify this assumption. The prices used were current new mill prices for X-46 pipe.

Definitions and Comparisons

Payout . . . The payout as calculated is the generally accepted concept used by the industry in comparing alternates. After it is decided that an enlargement must be accomplished and is justified, this type of payout is then calculated to find the best possible means of attaining the enlargement. This payout is defined as the number of years required for the net savings in operating costs to equal the difference in investment between the two methods being compared. The net savings is after income tax and before depreciation. This can be stated in the following form:

Payout of Loop over the Booster = (Inv. Loop — Inv. Booster)/[(1 — Inc. Tax.) (Oper. Cost Booster — Oper. Cost Loop) + Inc. Tax (Deprec. Loop — Deprec. Booster)].

The same type of calculation is used in the comparison of the automatic station with the manned booster station. It should be pointed out that the absolute payout of any one of the three solutions will depend upon the revenue, which, in turn, is related to the tariffs. It must be assumed in each case that the economics or



AUTOMATIC STATIONS win out over manned stations as long as 2.75-year payout is acceptable. Fig. 1.

some other consideration would be sufficient to justify one of the three methods of solution.

System studied . . . The unit established for study was assumed to be an initial station and a single-line system comparing size and distance to the next station. Sizes of line selected for study were 8-in., 10-in., and 12-in. line with loop lines of the same size. In actual situations, looping with larger lines often occurs because of the desire to enlarge the system considerably above the 100 per cent increase in capacity. Equal-diameter loops were used because the most economical size of a single-length loop is one in which a minimum difference exists in the diameters of the original line and the loop line.

Original station spacings of 30, 50, 75, and 100 miles were used as the basis for establishing the initial conditions and the curves were plotted for these spacings. The original station will require the same volume and pressure for any capacity increase by use of either a loop line or a booster. So the costs, both investment and operating, at the original station will not enter into the comparison. Only the additional investment and additional operating cost introduced by the method of securing the capacity increase will enter into the payout calculations.

Discussion and Conclusions

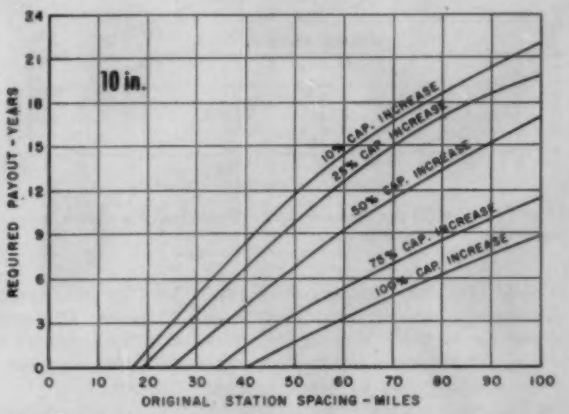
Automatic vs. manned station . . . Fig. 1 shows the comparison between the use of an automatic station and a manned station. Upon plotting these curves on the graph showing the payout vs. percentage capacity increase, it was found that the points were grouped sufficiently close that the payout could be said to be a constant of 2.75 years for all sizes of lines and all station spacings.

This shows that the use of the automatic stations under the assumptions of this article would be justified over the manned station under any condition as long as the 2.75-year payout is acceptable. This is a measurement of the investment required for the automation against the savings in operating cost through the elimination of personnel.

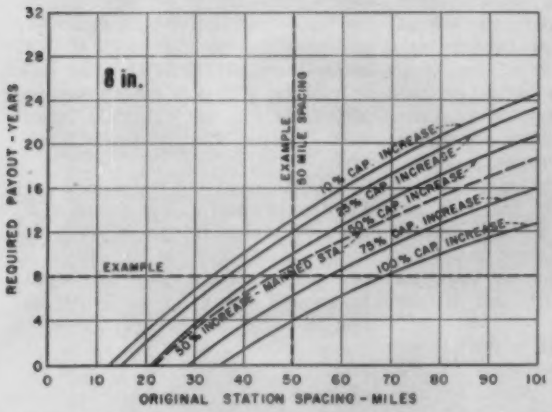
Loop vs. automatic booster . . . Figs. 2, 3, and 4 show a comparison of the loop vs. the automatic booster station for 8-in., 10-in., and 12-in. line respectively. These curves show the required payout in years plotted against the original station spacings in miles for varying percentage capacity increases.

It should be noted that the smaller the number of years required for the payout the more the loop will be favored. If, for example, 8 years is the required payout and the original station spacing is 50 miles, then for a 50 per cent capacity increase an automatic booster station would be

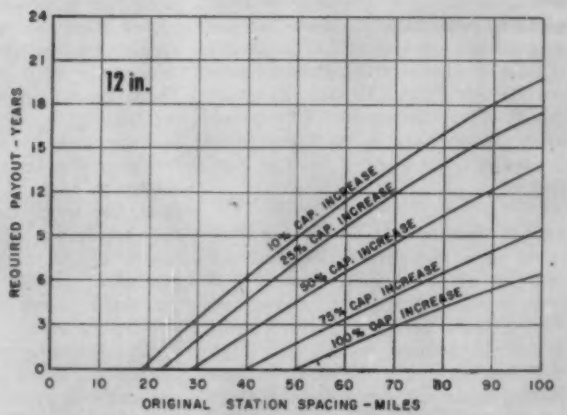
Loop vs. Automatic Booster Station



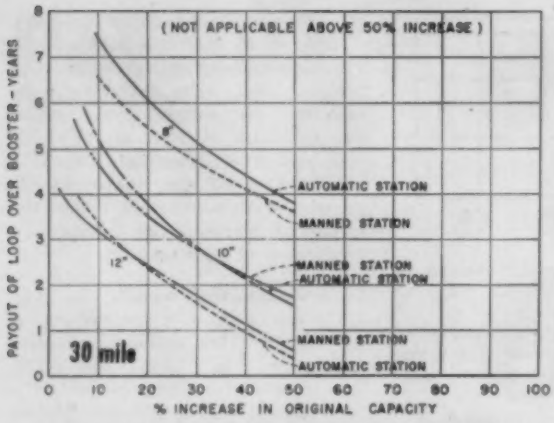
LOOP FAVORED more as payout requirement decreases. Fig. 3.



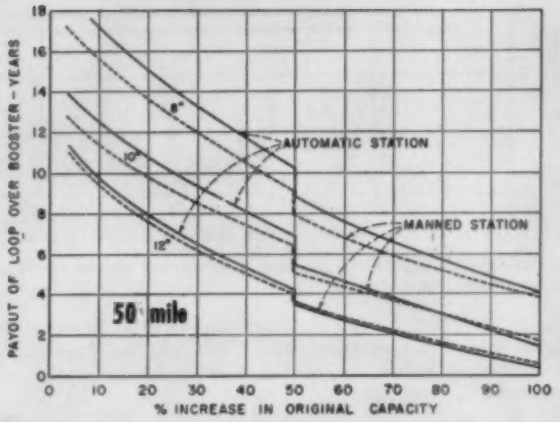
AUTOMATIC BOOSTER favored for 8-year payout, 50-mile spacing, 50 per cent capacity increase. Fig. 2.



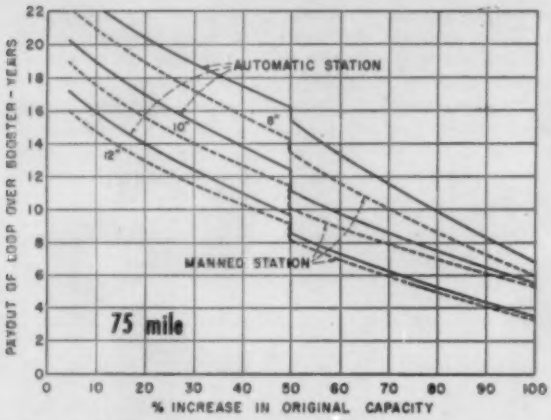
COMPARISON of three payout curves indicates increase in years to pay out for a given percentage capacity increase with decreasing line size. Fig. 4.



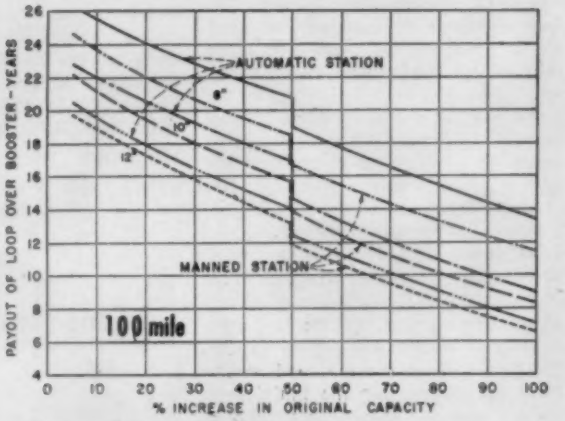
DISCONTINUITY IN CURVE shows point above which two stations required. Fig. 5.



MANNED AND AUTOMATIC station curves switch positions at 2.75 years, with manned stations favored below this point. Fig. 6.



LOOP FAVORED for increases up to 50 per cent for station spacing below 70 miles. Fig. 7.



BOOSTER FAVORED above 70-mile station spacing. Fig. 8.

favored. For any increase above approximately 60 per cent, the loop would be favored. Volume increases above 50 per cent require two stations, which tends to favor looping the line.

Comparison of the three curves—Figs. 2, 3, and 4—indicates an increase in years to pay out for any given percentage capacity increase with decreasing line size. This would indicate a degree of correlation favoring the use of the booster station as the line size decreases. This possibility would have to be investigated for many other sizes of lines to confirm.

Station spacing . . . The payout curve of a loop over a manned station for an 8-in. line at a 50 per cent volume increase is shown on Fig. 2. This curve indicates the decrease in station spacing in miles that can occur for the same payout. Noting again the example of 8 years as the required payout, the station spacing for the manned station is shown to be 46 miles, while for the loop vs. the automatic station, it is 43 miles. This gives some indication that the optimum station spacing will decrease with the use of automatic stations.

Payout vs. capacity increase . . . Figs. 5 through 8 show the same data plotted in a different manner. These curves show the years to pay out as against the percentage capacity increase for the various size lines. These are plotted on curves indicating the 30, 50, 75, and 100-mile station spacings. Two curves are shown for each size line. One curve represents the loop vs. the manned station; the other curve, the loop vs. the automatic station. The discontinuity shown in the curve at the 50 per cent capacity increase indicates the point above which two statons will be required.

An interesting point to note is the change in relative positions of the manned and automatc curves and the very low payout figures. As stated before, the automatic station should pay out over the manned station in approximately 2.75 years. The two curves plotted for each size line change their relative position at about the 2.75-year point. Above this point the automatic-booster-station curve is always above the manned station curve while they change positions below this point. This would have practical significance if, for some reason, the loop could not be built to achieve the high increase in capacity. The manned station would then be built only if the 2.75-year payout was unacceptable for the additional investment required for automatic operation.

Loop or booster? . . . It is seen in almost all cases if the capacity increase is expected to be above 50 per cent, then the loop line would be favored except for the longer station spacing (somewhere above 70 miles). For increases up to 50 per cent, the loop will be favored for spacings below approximately 70 miles, while the booster is generally favored above the 70-mile station spacing. If a second increase in capa-

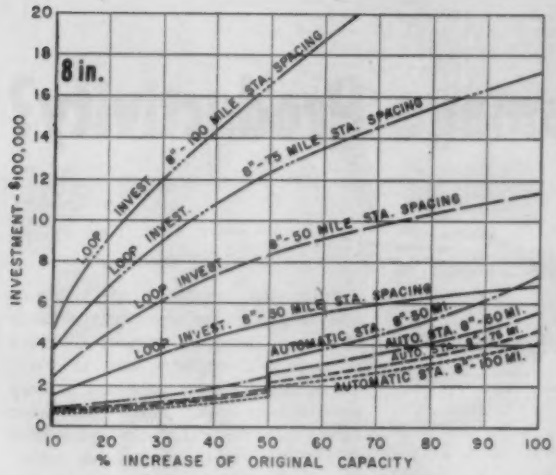

8 in.
INVESTMENT - $100,000
% INCREASE OF ORIGINAL CAPACITY
LOOP INVEST. 8"-100 MILE STA. SPACING
8"-75 MILE STA. SPACING
LOOP INVEST.
8"-50 MILE STA. SPACING
LOOP INVEST. 8"-30 MILE STA. SPACING
AUTOMATIC STA. 8"-50 MI.
AUTO. STA. 8"-50 MI.
AUTO. STA. 8"-75 MI.
AUTOMATIC STA. 8"-100 MI.

Fig. 9.

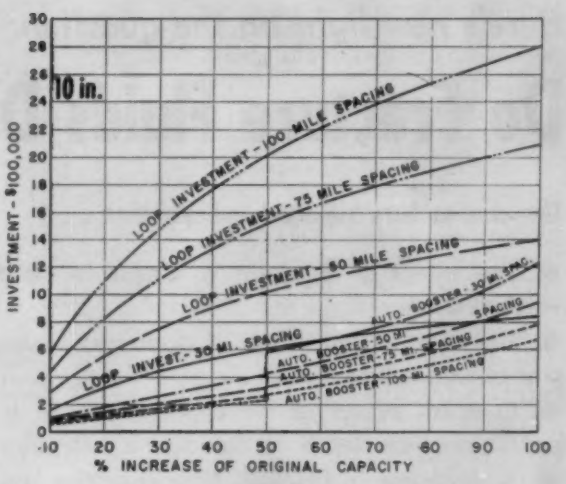

10 in.
INVESTMENT - $100,000
% INCREASE OF ORIGINAL CAPACITY
LOOP INVESTMENT - 100 MILE SPACING
LOOP INVESTMENT - 75 MILE SPACING
LOOP INVESTMENT - 50 MILE SPACING
LOOP INVEST. - 30 MI. SPACING
AUTO. BOOSTER - 50 MI. SPACING
AUTO. BOOSTER - 75 MI. SPACING
AUTO. BOOSTER - 100 MI. SPACING

Fig. 10.

city is to be experienced on a system that would cause the capacity increase to go from below 50 per cent to above 50 per cent, then it would be easier to economically justify handling this second increase if the loop had been chosen initially. If the booster station had been built, this would have the effect of switching the station to a second curve of one-half the station spacing of the original situation.

Investment Costs

Loop lines . . . The investment costs of the loop lines for the various sizes were as follows:

. . . 8-in.—$23,000 per mile.
. . . 10-in.—$28,000 per mile.
. . . 12-in.—$33,000 per mile.

This is based on normal cross-country construction without extraordinarily high construction costs on river crossings.

Station construction . . . Station construction was predicated on outside units with a concrete-block switchgear and supervisory equipment building. Costs were assumed as follows:

. . . 8-in.—$20,000 + $150 per hp.
. . . 10-in.—$23,000 + $150 per hp.
. . . 12-in.—$27,000 + $150 per hp.

Supervisory and telemetering costs . . . A single channel was required for the supervisory equipment and costs were varied to accommodate the number of pump units required.

Ten protective and alarm functions were established for the supervisory equipment. They were for each unit:

1. Discharge-valve operation.
2. Suction-valve operation.
3. Start and stop main unit.
4. High station discharge pressure.

Investments

(For loop line and for the automatic booster station)

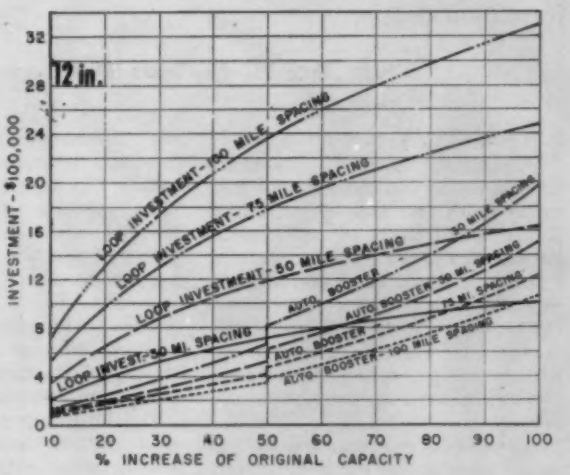

12 in.
INVESTMENT - $100,000
% INCREASE OF ORIGINAL CAPACITY
LOOP INVESTMENT - 100 MILE SPACING
LOOP INVESTMENT - 75 MILE SPACING
LOOP INVESTMENT - 50 MILE SPACING
LOOP INVEST. - 30 MI. SPACING
AUTO. BOOSTER - 50 MI. SPACING
AUTO. BOOSTER - 75 MI. SPACING
AUTO. BOOSTER - 100 MILE SPACING

Fig. 11.

5. Low suction shutdown.
6. Seal failure.
7. Bearing failure (pump and motor).
8. High pump-case temperature.
9. Channel failure (one per station).
10. High sump alarm (one per station).

The following values were required to be telemetered from the booster station:

1. Suction pressure.
2. Discharge pressure.
3. Station case pressure.

Thus, four channels were required for each intermediate station.

Investment costs were used as follows:

Supervisory . . . $7,500 + $230/point + $3,000 for channel, or:
1-unit station—$12,800.
2-unit station—$14,640.
3-unit station—$16,480.
4-unit station—$18,320.

Telemetering . . . $2,000/function + $3,000/channel or $15,000/station.

Investment Curves

Figs. 9, 10 and 11 show the investments used for the loop line and for the automatic booster station. In each case, in the interest of clarity, the investment curves for the manned station were omitted. They can, however, be derived from material given in the report.

Acknowledgments

The author wishes to acknowledge the help given by G. H. Beck, Senior engineer, Continental Pipe Line Co., in the preparation of the basic data, and by J. C. Phelps, manager of development and technical advisor, Continental Pipe Line Co., for his assistance and counseling in writing and reviewing the manuscript.

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1. "The Design of Oil Trunk Pipe Lines," by Oscar Wolfe (The Oil and Gas Journal, August 29, 1929).

Here's new light on the question:

Do Fracture Fluids Damage Productivity?

The studies here reported indicate that . . .

- The effect of damage is larger in horizontal than in vertical fractures.
- The detrimental effect of damage increases with a decrease in fracture sizes.
- Over-all effect of formation damage is of minor importance since depth of damage is only about 1 in.
- A decrease in fracture flow capacity results in a lower productivity and is of more concern than damage to the formation proper.

by Dr. H. K. van Poollen

LABORATORY tests performed by various research organizations have indicated that the different fracturing fluids and their additives have a detrimental effect on the effective permeability of the treated formations. Apparently this effect results in a permeability reduction which extends into the formation to a depth of approximately 1 in. The loss of permeability in the damaged zone ranges from 0 to 95 per cent of the original permeability.

By means of mathematical analyses of electrical models the effect of various degrees and depth of damage of the permeability surrounding the well bore and the fracture has been determined. The data indicate:

1. Increased well productivity can be obtained by fractures opening up a flow channel through the damaged zone (skin) around the well bore.
2. The larger the fracture, the greater is the productivity increase.
3. An increase in the flow capacity of the fracture results in greater production potential.
4. The damage to the formation immediately surrounding the fracture has only a minor effect on the productivity of the well.
5. The damage to the fracture flow capacity has a major effect on the productivity of the well.
6. Most production will enter the fracture in that portion of the fracture farthest away from the well bore.

Author is with Halliburton Oil Well Cementing Co., Duncan, Okla. Paper presented at the 1957 spring meeting of the Southwestern District, A.P.I., Division of Production, Dallas, under the original title, "Productivity vs. Permeability Damage in Hydraulically Produced Fractures."

TABLE 1—DISTRIBUTION OF OIL FLOWING INTO A FRACTURE*

FLOW-LINE NUMBER[†]		0	1	2	3	4	5	6	7	8	9	10	Flows per cent P_f
HORIZONTAL FRACTURE WITH INFINITE FLOW CAPACITY (F)		0	74	84	89	92.5	95	97	98	99	99.5	100	
VERTICAL FRACTURE WITH INFINITE FLOW CAPACITY (F)		0	17	31	46	60	72	82	91	96	99	100	
VERTICAL FRACTURE WITH VARYING FLOW CAPACITY (F)	F = 4	0	--	0.3	0.9	1.5	2.3	4.7	14.4	47.1	90	100	
	F = 30	0	0.6	1.2	2.1	6.6	20.6	39.5	60.7	80.5	96	100	
	F = 84	0	5.0	19.2	33.3	46.5	58.6	69.9	80.5	89.2	96.7	100	
	F = 1400	0	16.6	31.8	46	58.7	70.1	80	87.3	93.5	97.1	100	

* Numbers in table refer to the distance away from the well bore where each flow line enters the fracture expressed in per cent. (0 per cent = well bore, 100 per cent = end of fracture).

† Flow lines No. 0 and No. 10 represent 5 per cent, and all other flow lines represent 10 per cent of the oil flowing.

Plugging Problem

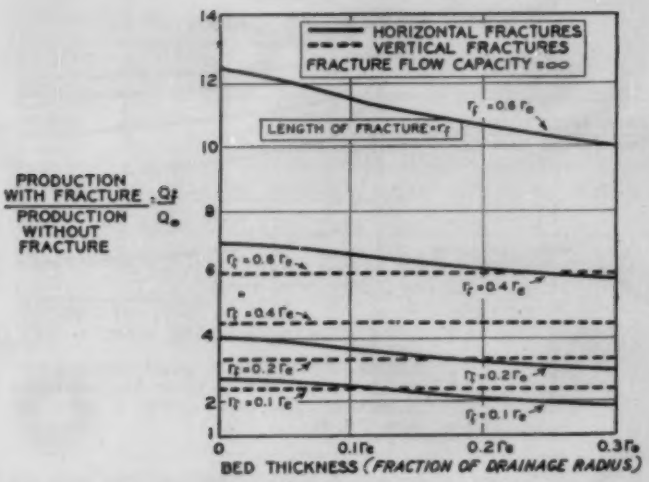
Since the beginning of hydraulic fracturing 8 years ago, various fluids have been used to fracture different subsurface formations and to carry the propping agents necessary to keep the fractures open. These fluids have varied from natural crudes and refined oils to salt water and fresh water. Chemical additives are frequently used to "custom fit" the fracturing fluids for their particular purposes.

In actual practice, frequently this question arises: "What are the possible detrimental effects of the various fracturing fluids and their additives on the effective permeability of the treated formation?" Various research organizations and an A.P.I. study group are at this time searching for an answer to this question. Even though no definite results have been published, tests indicate that the depth of permeability damage is in the range of 1 in. In this zone the loss of permeability ranges from 0 to 95 per cent of the original permeability.

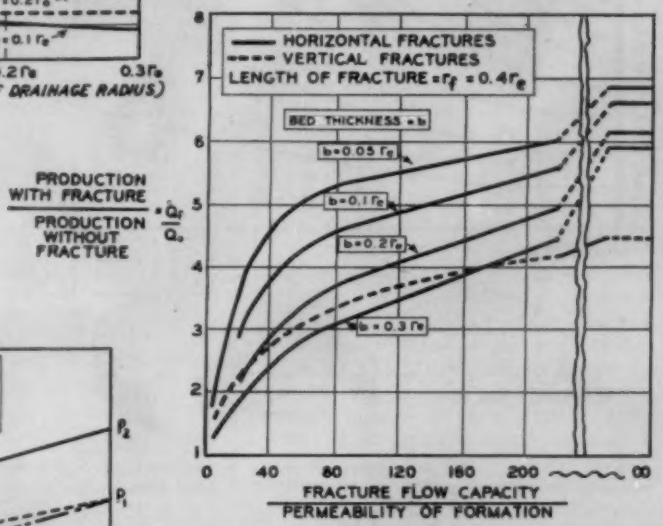
Models . . . This paper presents mathematical analyses of an electrical-model study of the influence on production of various degrees of damage surrounding the well bore and the fracture. Two electrical models were used, one for horizontal and one for vertical fractures.

Using these models, two important factors were studied: (1) the effect of various fractures on productivity; and (2) the pressure profiles surrounding a fracture. The data obtained from (1) were plotted for comparison; the pressure profiles (2) were used to calculate the effect of permeability damage on productivity. Both fractures with infinite and finite flow capacities were studied.

In all cases, the following assumptions were made: The formation is homogeneous and isotropic (constant permeability, constant porosity); the fluids are incompressible and homogeneous; the system is in a steady state of flow, and the effect of gravity is ignored. These assumptions will definitely limit the numerical results of this study; however, certain trends will

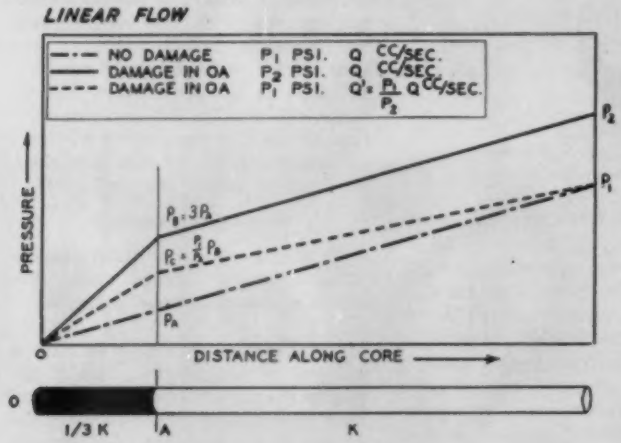


FRACTURE LENGTH considerably affects productivity increase. Bed thickness has a minor effect for infinite fracture capacity. Fig. 1.

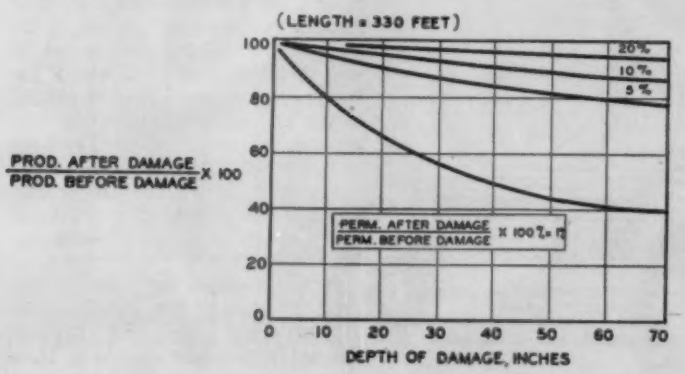


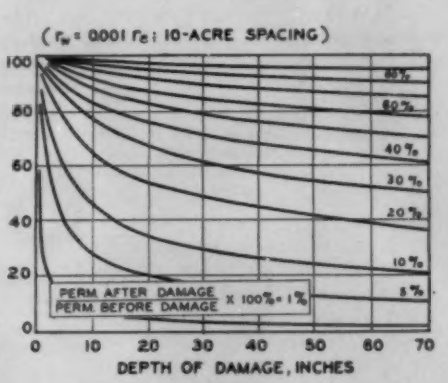
FRACTURE CAPACITY for fluid flow can change the productivity increase greatly. Low fracture capacity hurts productivity of thick beds most. Fig. 2.

PRESSURE DROP in linear flow is increased when damage occurs. For same pressure drop, flow rate decreased. Fig. 3.



PERMEABILITY DAMAGE in linear flow system is not serious unless depth of damage is great. Fig. 4.





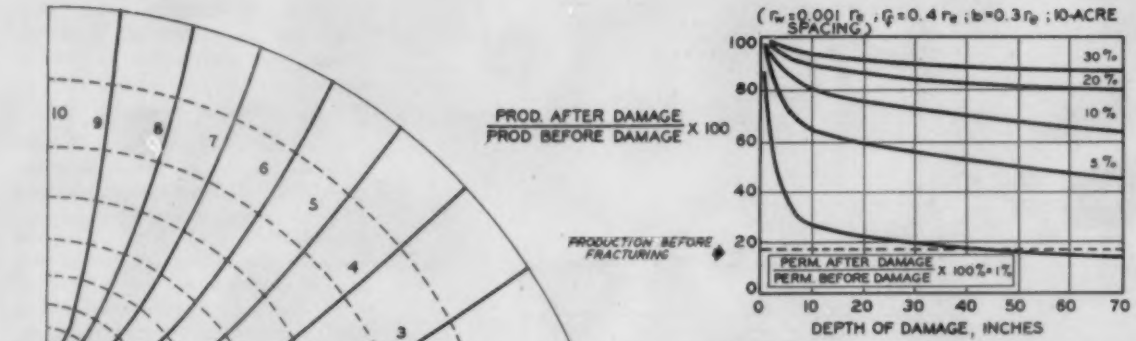
PERMEABILITY DAMAGE in radial flow system decreases productivity much more than in linear flow system. Fig. 5.

be similar to those in actual field cases, and the effect of formation damage can nevertheless be demonstrated.

Effects of Fractures

From the analyses of the two electrical model studies, trends were derived of the effect of various fractures on productivity. In Fig. 1 the increase in productivity for both horizontal and vertical fractures is shown with respect to bed thickness and length of fracture. The fractures are considered to have an infinite flow capacity.

Note that a larger fracture results in an increased productivity of the well. Up to reasonable values for the bed thickness (0.3 times radius of drainage), productivity increases are virtually independent of the bed thick-


(rw=0.001 re ; rf=0.4 re ; b=0.3 re ; 10-ACRE SPACING)
PROD. AFTER DAMAGE / PROD BEFORE DAMAGE X 100
PRODUCTION BEFORE FRACTURING
30%
20%
10%
5%
PERM. AFTER DAMAGE / PERM. BEFORE DAMAGE X 100%=1%
DEPTH OF DAMAGE, INCHES

FORMATION DAMAGE around horizontal fracture reduces productivity. Productivity will exceed prefractured value unless damage is severe and deep. Fig. 8.

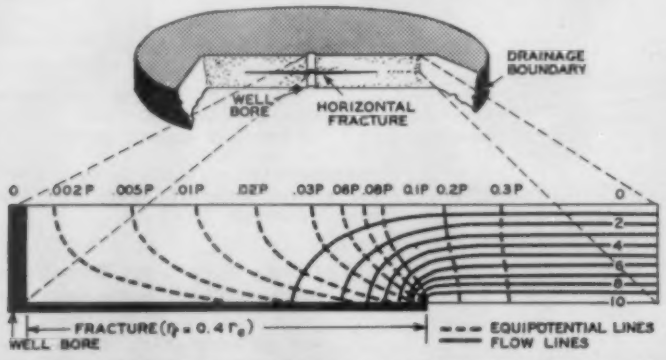
VERTICAL-FRACTURE flow pattern is shown by dashed equipotential lines and solid flow lines. Fig. 6.

ness for a given size horizontal fracture. Productivity increase as a result of vertical fractures is entirely independent of the bed thickness provided the fracture extends from top to bottom of the formation.

Fracture capacity . . . In Fig. 2 the effect of decreasing "flow capacity"* of the fracture is shown. The length of the fracture is the same in all instances (0.4 times radius of drainage). It can be noted that a decrease in fracture flow capacity greatly diminishes the productivity of the well.

The effect of fracture-flow capacity reduction is of more concern than damage to the permeability of the formation surrounding the bore hole or fracture. This will be elaborated upon later. From Figs. 1 and 2, one can readily observe that both the size and the flow capacity of fractures are of major importance.

*Flow capacity of horizontal fractures is ratio of conductance of 1 square unit of fracture to conductance of 1 cc. of formation. Flow capacity of vertical fracture is ratio of conductance of 1 cm. of fracture to conductance of 1 square unit of formation.



HORIZONTAL FRACTURE receives most of the produced fluid at its outer radius (b = 0.2 r_e). Fig. 7.

A point of interest derived from this study is the distribution of oil flow into the fracture as shown in Table 1. Flow lines No. 0 and 10 each represent 5 per cent of the oil movement. Flow lines No. 1 through 9 each represent 10 per cent of the oil movement. It can be seen that as much as 60 per cent of the oil enters the 10 per cent portion of the horizontal fracture which extends farthest into the formation. In the case of a vertical fracture with high flow capacity, as much as 40 per cent of the oil flows into the last 10 per cent portion. If the flow capacity of the fracture decreases, the oil will then enter the fracture nearer the well bore.

Permeability Damage

To arrive at a better understanding of permeability damage effect, the following calculations are presented.

Linear flow . . . In Fig. 3 we have a pressure profile OP_AP_1. This is the profile of a cylindrical core of constant permeability (K); P_1 (psi.) is required to move Q (cc. per second) through the core.

Established next that the core is damaged in the zone OA to such a degree that the permeability has decreased to ⅓ K. Therefore, three times as much pressure is required to move the same amount of fluid through that damaged portion of the core, or $P_B = 3\,P_A$. Here it can be seen that from this new point P_B to P_2 the pressure profile will be parallel to the original profile, and the total pressure necessary to move Q amounts to P_2 instead of P_1.

If only P_1 is available, the production rate will be reduced to (P_1/P_2) Q which results in a new pressure profile OP_CP_1.

In this manner, the effect of permeability damage was calculated for a 330-ft.-linear system with a depth of damage ranging from 0 to 70 in. These

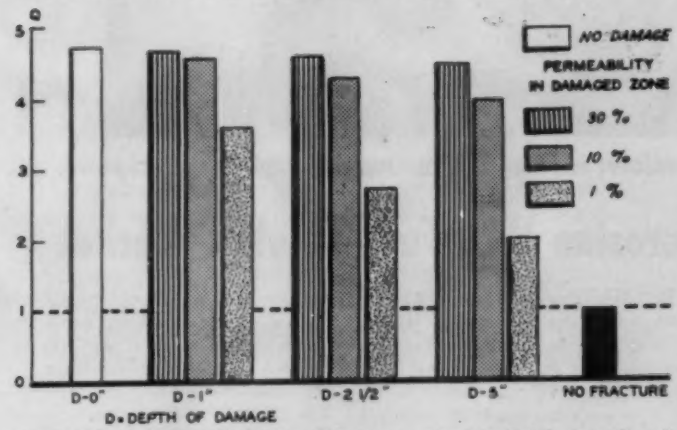
TABLE 2—EFFECT OF PERMEABILITY DAMAGE ON WELL PRODUCTIVITY, 10-ACRE SPACING

Prod. of well with fract.; no damage / Prod. of clean well; no fract.				Depth of Penetration								
				1 in.			2.5 in.			5 in.		
				Percentage of Permeability Left in Damaged Zone								
		Q_o	Q_f	1%	10%	30%	1%	10%	30%	1%	10%	30%
No Fracture		1	-	0.32	0.82	0.96	0.17	0.71	0.91	0.11	0.59	0.85
Linear Flow		1	-	0.96	1.00	1.00	0.93	0.99	1.00	0.87	0.98	1.00
r_f*	F†	Vertical Fracture										
0.1		1	2.4	2.0	2.4	2.4	1.6	2.4	2.4	1.3	2.3	2.4
0.2		1	3.5	3.1	3.4	3.5	2.6	3.4	3.4	2.1	3.3	3.4
0.4		1	4.5	4.1	4.5	4.5	3.5	4.4	4.5	2.9	4.3	4.5
0.6		1	6.1	5.5	6.0	6.1	4.7	5.9	6.1	4.1	5.9	6.1
0.4	4.2	1	1.6	0.6	1.3	1.5	0.3	1.1	1.4	0.2	0.8	1.3
0.4	29.8	1	2.6	1.7	2.4	2.5	0.9	2.2	2.5	0.5	1.9	2.4
0.4	8h	1	3.3	2.0	3.1	3.3	1.2	2.8	3.2	0.8	2.6	3.1
0.4	1400	1	4.3	3.2	4.1	4.3	2.1	3.9	4.2	1.2	3.5	4.0
0.4		1	4.5	4.1	4.5	4.5	3.5	4.4	4.5	2.9	4.3	4.5
r_f	b‡	Horisontal Fracture										
0.1	0.2	1	2.2	1.4	2.0	2.1	0.7	1.7	2.0	0.3	1.4	1.9
0.2	0.2	1	3.3	1.9	3.0	3.2	1.1	2.6	3.1	0.5	2.2	2.9
0.4	0.2	1	6.2	5.1	6.0	6.1	3.9	5.8	6.1	2.5	5.5	6.0
0.6	0.2	1	10.6	8.7	10.2	10.5	7.2	9.7	10.5	5.4	9.1	10.4
0.4	0.05	1	6.9	6.3	6.9	6.9	5.7	6.8	6.9	5.0	6.7	6.9
0.4	0.1	1	6.6	5.3	6.5	6.6	4.5	6.3	6.5	3.7	6.1	6.5
0.4	0.2	1	6.2	5.1	6.0	6.2	3.9	5.8	6.1	2.5	5.5	6.0
0.4	0.3	1	5.9	4.5	5.7	5.8	3.4	5.3	5.7	2.2	5.0	5.7

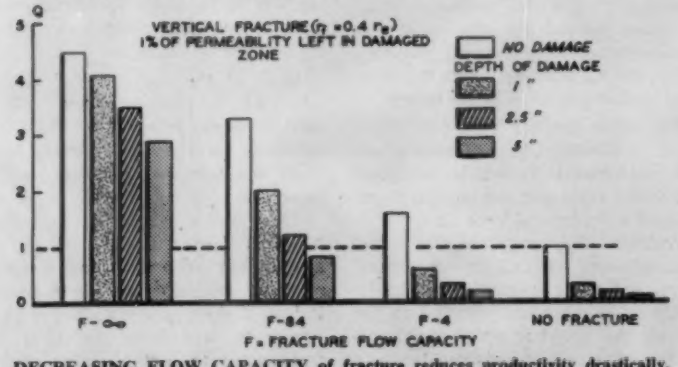
* r_f = extent of fracture expressed as a fraction of the radius of drainage (r_e).

† F = fracture flow capacity.

‡ b = bed thickness expressed as a fraction of the radius of drainage.



AVERAGE PRODUCTIVITY for all fracture systems studied is not affected greatly by usual depth and degree of permeability damage. Fig. 9.



DECREASING FLOW CAPACITY of fracture reduces productivity drastically. Combined with permeability damage around fracture, low capacity may result in productivity below prefractured value. Fig. 10.

calculations were performed assuming that 1, 5, 10, and 20 per cent of the original permeability was retained in the damaged zone. The results of these calculations are plotted in Fig. 4.

Radial flow . . . The same principle of damage-effect calculation can be applied to a radial-flow system as in the case of linear flow. Here again we see that, if the permeability is reduced to a certain value, the productivity is reduced to $(P_1/P_2) \times 100$ per cent of the original productivity. In Fig. 5 the calculations of damage effect are presented for a 10-acre well-spacing system.

Comparison of Figs. 4 and 5 indicates that the effect of permeability damage is greater in a radial-flow system than in a linear-flow system, where this effect will be of intermediate magnitude in the case of hydraulically fractured formations.

Fractured formations . . . Where both linear and radial-flow systems can be calculated by simple mathematics (because the pressure profiles are well established in the literature), the fractured system requires either complicated calculations or the use of model studies. The latter method was used.

In Figs. 6 and 7 the flow patterns are presented for both a system with a vertical fracture and a horizontal fracture. This data was used to determine the average pressure profile of each system. First the pressure profile along each flowline was measured. These profiles were then averaged with a weight of 0.5 for flow line No. 0 and 10 and a weight of 1 for all other flow lines. Using these average pressure profiles, the effect of damage was calculated in the same manner as it was for linear and radial flow.

The length of the fracture varied from 0 to 0.6 times the radius of drainage; the fracture flow capacities varied from 0 to ∞. The results of these calculations were plotted for 17 different systems. One of these graphs is Fig. 8. Here the effect of formation damage on productivity is shown for a horizontal fracture, the length of which is 0.4 times the radius of drainage. The bed thickness is 0.3 times the radius of drainage, and the flow capacity of the fracture is assumed to be infinite.

The dotted horizontal line indicates the productivity of the well before fracturing and without permeability damage around the well bore. In this case, an undamaged fracture would increase the productivity from 17 to 100 per cent. However, if the formation surrounding the fracture were damaged to a depth of 10 in., and the permeability in that zone was reduced

to 10 per cent of its original value, productivity would be 79 per cent.

Even with the formation damaged to this extent, the productivity will still exceed that of a formation without a fracture. But if the depth of damage were 70 in. and the permeability decreased to 1 per cent, the productivity would only be 14 per cent, which is less than it would have been had the formation not been fractured.

Different systems . . . The effect on productivity for the different fracture systems is shown in Table 2. The tabulated depths of damage are 1 in., 2.5 in., and 5 in.; the permeability in the damaged zone is reduced to 1, 10, and 30 per cent of the original permeability. Assuming productivity of an unfractured, clean well to be unity, the respective productivity increases and decreases after fracturing and/or damaging the formation are shown as multiples or fractions of 1.

Based upon the results listed in Table 2, the following remarks can be made:

1. The effect of damage is larger in horizontal fractures than in vertical fractures.
2. The detrimental effect of damage increases with a decrease in fracture size.
3. Considering the fact that the depth of damage is usually only in the order of 1 in., the over-all effect of formation damage is of minor importance.
4. A decrease in fracture flow capacity results in a lower productivity and is of more concern than damage of the formation proper.

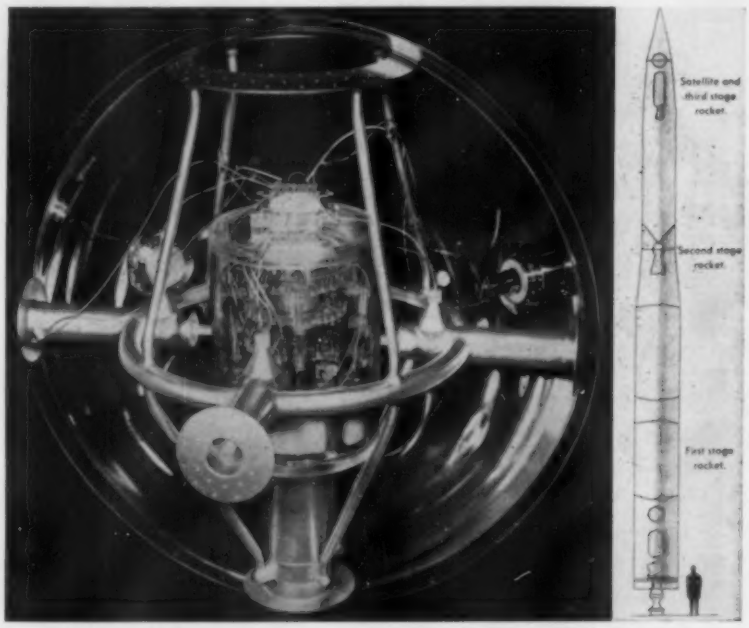
Relative effect . . . To dramatize points 3 and 4, two graphs are presented (Figs. 9 and 10). In Fig. 9 the effect on productivity of fractured formations with various depths and degrees of damage is illustrated. The average values of all fracture systems studied in this paper are used. As can be noticed, the average productivity of an undamaged and fractured well is about 5 times the productivity of the well without a fracture.

Each set of bars represents a certain depth of damage (1 in., 2.5 in., and 5 in.), where each bar in each set represents a certain degree of damage in the damaged zone (30, 10, and 1 per cent of original permeability left). This illustration brings out the fact that harm can be done to a fractured formation if fluids which cause permeability damage are used, but at the same time, it indicates that this harm is of no great importance.

In Fig. 10 the effect of formation damage on productivity is shown for systems with fractures of varying flow capacities. A well with a clean fracture of infinite flow capacity will have 4.5 times the productivity of an unfractured well. In that case the effect of formation damage is of minor influence even with only 1 per cent of the original permeability remaining. However, if the fracture flow capacity decreases, the productivity of the well decreases drastically and the effect of damage is severe. It is then possible to reduce the productivity to below the value of a clean unfractured well.

Acknowledgment

The author expresses his thanks to T. S. Hutchinson of The Atlantic Refining Co. for his valuable suggestions. Appreciation is expressed to the management of Halliburton Oil Well Cementing Co. for permission to present this paper.



Petroleum will figure in attempts to explore the unknown, as . . .

Kerosine Will Fuel Satellite Rocket

SCIENTISTS developing the first stage of the three-stage rocket that will fire the earth satellite into outer space for the International Geophysical Year will use kerosine for fuel. It is a special grade of kerosine, furnished by Shell Oil Co., and produced by a closely controlled refining operation to give the particular characteristics needed for the rocket. It is being delivered to General Electric's Malta, N. Y., test site where the first-stage rocket engine is being tested.

The earth satellite is a ball about 20 in. in diameter, packed with scientific instruments. It will be launched into space sometime during the International Geophysical Year (July 1957-December 1958) to gather new information about the earth, its atmosphere, and outer space.

Power to drive the satellite to the altitude and speed at which it will circle the earth will be provided by three rockets.

The first-stage rocket will drive the satellite to a height of about 40 miles and a speed of about 4,000 m.p.h. Then the first-stage rocket will be jettisoned and the second-stage rocket will take over, lifting the satellite to a height of 300 miles and a speed of 9,000 m.p.h. The third-stage rocket will not raise the satellite any higher but will increase its speed to 18,000 m.p.h.—the speed needed to establish the satellite in its orbit.

Most of the fuel ordered for the satellite's first-stage rocket will be used in development work. The actual launching will take relatively little. Once the satellite is in its orbit no more fuel will be needed.

The satellite is a one-way vehicle. When it drops out of its orbit and heads back into the earth's atmosphere it will burn up like a meteor. Before it does, scientists hope, its instruments will have recorded and transmitted to earth a great deal of information useful in planning further ventures into space.

EVALUATING D.S.T. DATA—4

Here's a field method for

Finding Well-Bore Damage From Drill-Stem Tests

By Albin J. Zak, Jr., and Phil Griffin III

TO be a usable tool, the drill-stem test must yield information concerning well productivity and well-bore damage even before the well is completed. Interpretation of the test must be fast and accurate.

If pressure-volume-temperature data along with porosity and permeability data are available, a fast and accurate interpretation can readily be made; but this is seldom the case. The usual situation is that core analysis of the producing interval may or may not be available and P.V.T. data are almost never available until some time after the well is completed.

In the case of small, one or two-well fields, economics may never warrant the procurement of P.V.T. data, and a wildcat well will never have P.V.T. data available. Therefore, if the drill-stem test is to be effectively used in determining the degree of well-bore damage, an empirical method of solution of the pressure buildup must be resorted to.

Empirical Method

The skin equation

$$S = 1.151\ [(P_o - P_f)/m - \log (K/f\,\mu\, c r_w^2) - \log T + 2.85] \qquad (3)$$

shows that there are four parameters which cannot be determined directly from the drill-stem test. They are: porosity (f), permeability (K), viscosity (μ), and fluid compressibility (c).

As previously discussed (Part 3), permeability can be obtained directly from the drill-stem test if a good fluid recovery is obtained. However, in low-permeability wells and in wells with a substantially high skin effect, good fluid recoveries are hard to obtain. So, as considered here, the formation permeability will be treated as one of the unknown parameters.

The remaining parameters such as the reservoir pressure, flowing pressure, slope of the buildup curve, and flowing time can be determined directly from the drill-stem-test data report. This means that the parameters not ascertainable from the test must be replaced by an empirically determined constant.

Combined parameters . . . All of the unknown parameters are situated in the logarithmic term of the equation. Being a logarithmic term serves to have a "dampening" effect on error introduced by deviation of the parameters from their true values. Relatively large deviations of the parameters from their true values can be tolerated before any substantial error is introduced in the relationship.

To arrive at an empirical constant, a range of values for each of the parameters was selected to encompass the vast majority of the likely combinations of these parameters in the field.

The range of values selected are:

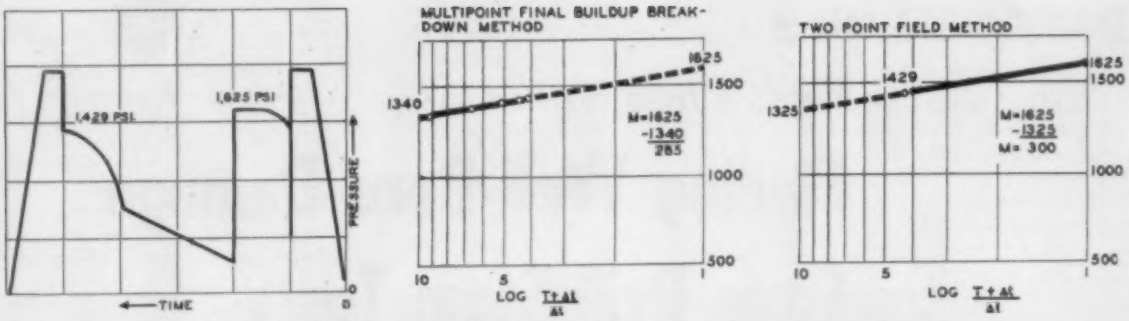
Effective oil permeability, K_o, md.—1 through 200.

The authors conclude . . .

1. The pressure-buildup theory is applicable to drill-stem testing.
2. Drill-stem test data can be used very effectively in determining (1) the average formation permeability within the drainage radius of the well; (2) well-bore damage or skin effect; and (3) the original, static reservoir pressure.
3. Drill-stem-test fluid-recovery rates cannot be used satisfactorily in predicting the open-flow potential of the well.
4. Well-bore damage can be efficiently estimated through the use of an empirical method requiring only pressure-buildup information from the drill-stem test.

. . . and recommend . . .

1. Use a fluid cushion during the drill-stem test to decrease variations of fluid viscosity and to prevent gas from coming out of solution.
2. Leave tool shut in at least one-half the open-flow time and preferably as long as the open-flow time. An open-flow time of 1 hour is preferred.
3. If possible, consult drill-stem-test records from wells tested in the same locality and in the same stratigraphic interval to find ratio of open-flow time to shut-in time for obtaining adequate pressure-buildup data.
4. Make initial shut-in pressure measurement to insure obtaining the original reservoir pressure in case shut-in time does not permit sufficient pressure buildup to enable extrapolation to reservoir pressure.



THE FIELD METHOD for getting the final slope of the buildup curve requires initial as well as final pressure buildup as at left. These two points give the slope on the job as at right. This method saves plotting the pressure buildup points and extrapolating as in the center graph. Fig. 9.

Porosity, f, fractional—0.10 through 0.30.

Fluid compressibility, c, vol./vol./psi.—10^{-6} through 10^{-4}.

Viscosity, μ, cp.—0.05 through 50.

Radius of well bore, r_w, in.—3⅞ through 4½.

No extreme values have been included. Admittedly, much higher and lower values of these parameters are encountered in drill-stem testing operations, but the above-listed ranges of values will cover the majority of situations found.

Having selected the range of values for the unknown parameters, the next step is to insert them in the pressure-buildup equation in such a manner as to obtain maximum and minimum values for the logarithmic term. Care is taken to combine the maximum value of viscosity with the minimum value of fluid compressibility and vice versa so as not to create any unreal results.

The maximum and minimum values are then averaged together and the resulting value substituted into the buildup equation in place of the logarithmic term. Averaging these terms assumes a straight-line relationship between viscosity and fluid compressibility which is not strictly true. However, this deviation is relatively small and considered entirely justifiable in this case. Computation of the average logarithm value is as follows:

Maximum value:

$$\log \frac{K}{f \mu c r_w^2} = \frac{200}{0.1\ (0.05)\ 10^{-4}\ (15.06)}$$

$$= 7.42$$

Minimum value:

$$\log \frac{K}{f \mu c r_w^2} = \frac{1}{0.3\ (50)\ 10^{-6}\ (19.2)}$$

$$= 3.54$$

Average value: 5.5

TABLE 5
Comparison Between Values of Slope as Computed by Two-Point Field Method and Final Shut-in Buildup Method

Test	From final shut-in break down	Two-point initial and final shut-in pressures
1	170	160
2	285	300
3	90	90
4	(*)	135
5	1,480	1,660
6	†25	0
7	37	37
8	1,010	875
9	76	57
10	440	390
11	980	980

*Insufficient shut-in time. †Pressure recorder friction.

Substituting in Equation 3:

$$S = 1.151 \times [(P_o - P_f)/m - \log T - 2.63^{*}] \quad (4)$$

*±2.

The correct slope to be used in Equation 4 is determined from an accurate plot of the increments of shut-in pressure increase vs. log $(T + \Delta t/\Delta t)$.

Getting slope . . . Due to the exactness with which the intermediate pressure-time points are measured, special micrometer-type optical chart readers must be used. It is almost impossible to accurately break down the pressure-time points at the well site. In order to use Equation 4 at the well site, it becomes necessary to establish a simplified method of slope determination. This same method of simplified slope determination can be applied to Equations 1 and 3.

Some drill-stem-testing service companies are now offering a double shut-in type of test. By rearrangement of the test-tool assembly, shut-in buildup pressures can be taken at the beginning as well as the end of the test.

The rearrangement offered simply allows bleedoff of initial hydrostatic mud pressure into an air chamber. Fluid flows from the reservoir into the well bore recompressing the expanded drilling fluid to reservoir pressure against a closed valve at the top of the air chamber.

When applying Equation 1 to the initial shut-in period, it is observed that log $(T + \Delta t/\Delta t)$ approaches zero rapidly in that T is only the small amount of time necessary for the reservoir to produce the volume of the air chamber.

It can be readily seen that as log $(T + \Delta t/\Delta t) \rightarrow 0$ then $P_w \rightarrow P_o$.

Use two pressures . . . Both the initial and final shut-in pressures can be closely measured in the field due to the sharp breaks on the chart at the completion of the shut-in period. By plotting the initial shut-in pressure at log $(T + \Delta t/\Delta t)$ equal 0 and by plotting the final shut-in pressure at log $(T + \Delta t/\Delta t)$ (where Δt equals the final shut-in time) a straight line between the two points should give a good estimate of the slope provided: (1) the initial shut in has leveled off and (2) the final shut in has shown a tendency to level off. (See Fig. 9 and Table 5.)

Comparison of methods . . . Table 6 shows a comparison between values of skin, or well-bore damage, as calculated by Equations 3 and 4. For the rigorous method all of the parameters needed to solve the buildup equation were known. For the empirical method, Equation 4 was used.

As can be seen from the table, values of skin computed by both methods are in reasonably good agreement. For the small values of skin between S = 0 and S = 5, deviation of only S = 1 would represent quite a large error, percentagewise. In this range of skin values, the well productivity would not be improved much by removal of such a small skin; and

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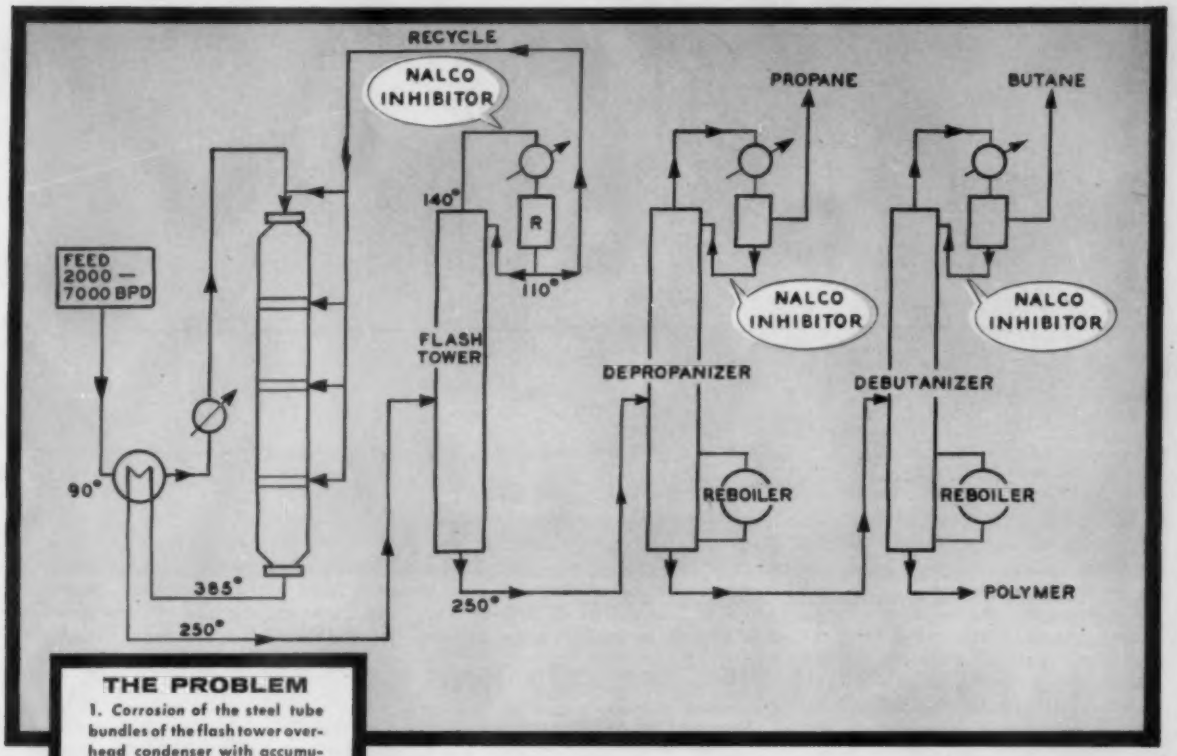
STOPPED CORROSION and FOULING

in this CATALYTIC POLYMERIZATION UNIT



THE PROBLEM

1. *Corrosion* of the steel tube bundles of the flash tower overhead condenser with accumulator water pH of 4.5 or below.
2. *Serious fouling* of screen trays in the depropanizer and debutanizer on normal six-month run.

THE TREATMENT

Nalco Inhibitor fed to the overhead of the flash tower, and to the reflux of the depropanizer and debutanizer towers.

THE RESULTS

1. Iron content of accumulator water reduced from .75 pounds per day to .04 pounds per day.
2. No deposits in screen trays after six-month run.

CONSIDER further the economy of dosage . . . 10 ppm to flash tower, and 10 ppm to depropanizer and debutanizer. And bear in mind that this was no isolated success story. The same advantages—less downtime, better thruput *and* effective protection for costly equipment—can be brought to your refinery by the use of Nalco Corrosion and Fouling Inhibitors. Ask your Nalco Representative or write direct.

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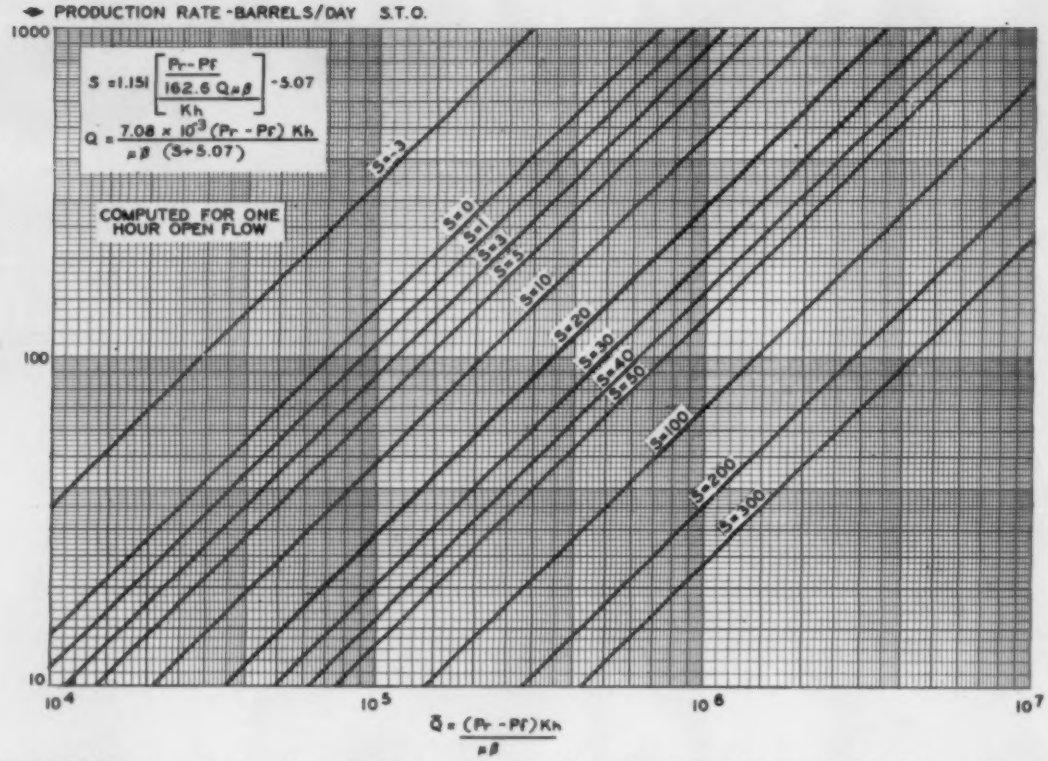


EFFECTIVE SKIN on a well reduces the productive capacity as shown here. Skin, S, is rapidly determined by the two-point pressure-buildup field method. Fig. 10.

correspondingly, a low-productivity well indicating so small a skin would not be aided much merely by removal of the well-bore damage.

Consequently, the seemingly large errors, percentagewise, have little effect in the practical evaluation of the drill-stem test. Values of skin greater than S = 10 are the ones of greatest interest since their presence or absence could mean the difference between an oil well or a dry hole in the case of low-permeability producing interval.

In the case of a potentially highly productive well, the presence or absence of well-bore damage greater than S = 10 will not ordinarily result in abandonment of the well prior to completion, but if not detected, it could mean the difference between a well that could make its allowable and one that could not be economically produced.

Skin vs. production . . . Fig. 10 shows the effect of skin on reducing the productive capacity of the producing interval. This figure shows that small values of skin, between S = 0 and S = 5, have only a slight effect on reducing the productive capacity. Productivity varies by a factor of 2 between these two values.

At higher values of skin the productive capacity becomes less sensitive to increases or decreases in well-bore damage. This clearly indicates that an error of S = 1 or S = 2 in the low range of skin values, between S = 0 and S = 5, as well as an error of S = 5 or S = 10 in the high range of skin values, above S = 10, will not result in erroneous results in determining whether a low productive capacity results from well-bore damage. Hence, this empirical method of skin determination could prove very valuable in developing the quantitative usefulness of the drill-stem test.

Use of this method will permit fast and reliable evaluation of well-bore damage even before completion of the well. Also to be considered is the fact that advantages from this method would be paramount when applied to a one or two-well field where there would be no likelihood of obtaining any P.V.T. analysis.

TABLE 6
Comparison Between Values of Skin as Computed by the Rigorous Method and Estimated by the Empirical Method

Well No.	Computed skin by Equation 3	Estimated skin by Equation 4
1	2.4	2.3
2	12.0	10.6
3	9.2	9.8
4	220.0	337.0
5	0	0.6
6	10.3	11.1
7	7.7	7.1
8	†<1.0	—0.5
9	2.5	1.3
10	—0.51	—4.2
11	2.0	2.9
12	0	—2.7
13	18.7	16.0
14	4.0	4.3
15	10.0	12.8
16	*35.0	34.2
17	†>100.0	146.6
18	*12.0	13.5
19	*9.0	9.0
20	*19.0	19.0
21	4.6	2.9
22	0	—0.5
23	1.0	0.4
24	0	1.2
25	2.1	2.5

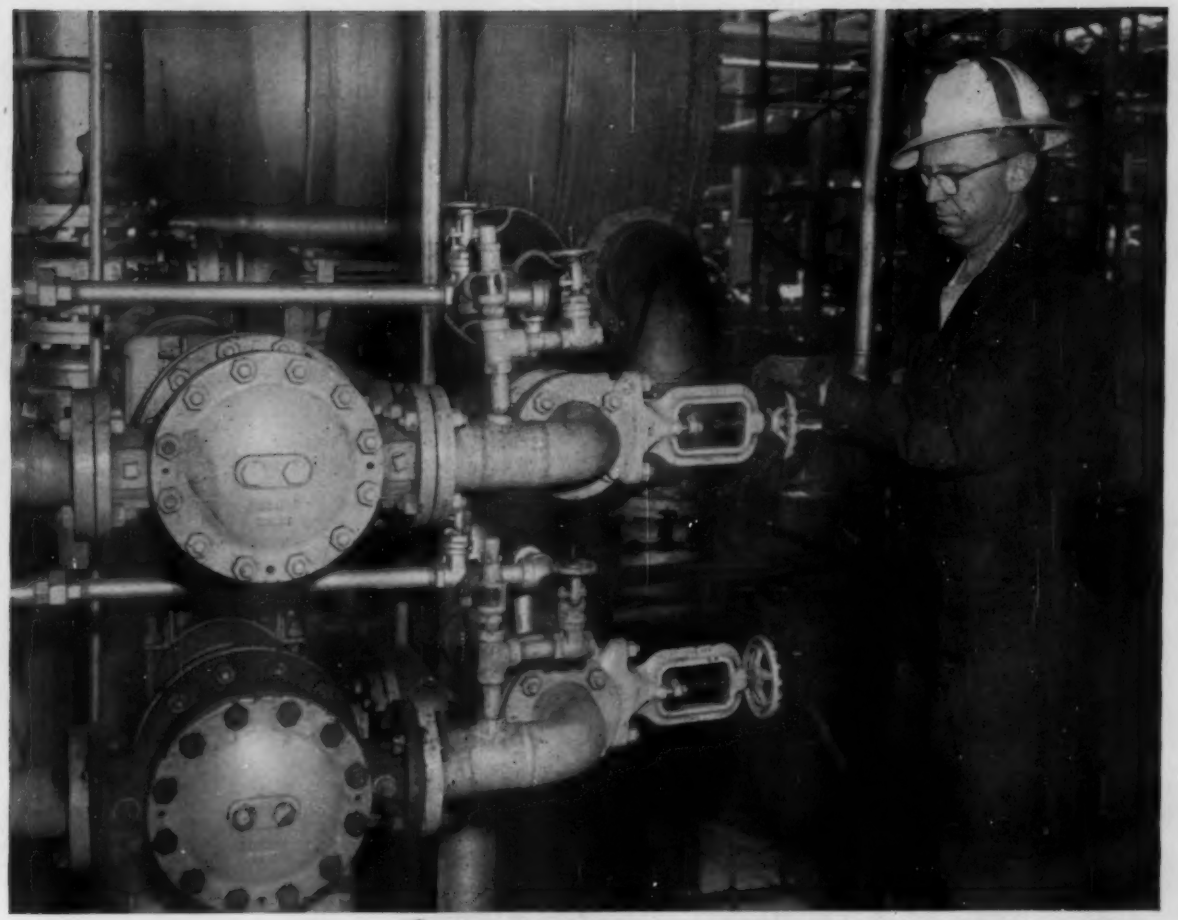
*Gas well. †Questionable slope.

Acknowledgment

Acknowledgment is given to Shell Oil Co. for releasing certain of its core analyses, pressure charts, and production data used in this report and also particularly to S. M. Paine of Shell for contributions of his experience in drill-stem-test analysis.

Final Installment

This is the final part of this article on evaluating drill-stem-test data. The first three parts appeared April 15, 1957, April 29, 1957, and May 13, 1957.



Crane Ni-Resist gate valves resist corrosion on lines to surface condensers.

CRANE Valves go "on stream" at Tidewater's new 130,000 barrel-per-day refinery

Our hats are off to the Tidewater Oil Company!

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Crane is proud to have played a part in this vast undertaking by supplying valves and piping materials for handling the many types of process and utility fluids in the new Delaware refinery.

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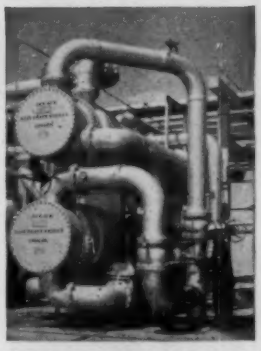

Crane gear-operated iron body valves on lines to reflux coolers.

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Rocky Mountain and Mid-Continent Survey

Here is a report of 58 projects now under construction or planned for the Rocky Mountain and Mid-Continent area. Next month a report will be presented for the East-Southeast area.

A

Advance Refining Co., Inc., will increase crude capacity 3,000 bbl. per day at Centralia, Ill., by September 1, 1957.

American Gilsonite Co. will complete by summer of 1957, a $5,000,000 plant near Grand Junction, Colo. Foster Wheeler Corp. has contract for a 4,000-bbl. per day delayed coker; H. K. Ferguson & Co. has a 1,750-bbl. per day catalytic reformer which is being engineered by California Research Corp.; Kaiser Engineers has a coke calciner to produce 250 tons per day.

American Oil Co. is increasing Ultraforming capacity 6,120 bbl. per day, and adding a 12,500-bbl. per day Standard Oil Co. (Ind.) hydrodesulfurization unit at El Dorado, Ark. (formerly Pan-Am Southern Corp.'s plant). Lummus Co. is contractor. Completion is set for January 1, 1958. Cost will be $3,200,000.

Anderson-Prichard Oil Corp. will increase crude capacity 6,500 bbl. per day, and straightrun asphalt capacity 250 bbl. per day at Arkansas City, Kans., by June 1, 1957. Blaw-Knox has contract for asphalt expansion.

B

British American Oil Co., Ltd., is adding a 4,000-bbl. per day catformer at Edmonton, Alta. Lummus Co. is contractor. Completion is set for end of 1957.

At Clarkson, Ont., crude capacity will be increased 40,000 bbl. per day and capacity of vacuum unit charging topped crude will be increased 22,200 bbl. per day by late 1957. M. W. Kellogg has contract.

C

Calumet Refining Co. will increase crude capacity 2,200 bbl. per day at Princeton, La., by June 1, 1957.

Canadian Oil Companies, Ltd., will increase Platforming capacity 4,400 bbl. per day, and add a 3,650-bbl. per day Udex unit at Corunna, Ont., by August 1957. Fluor Corp. has contract. Engineering and design are by U.O.P.

Champlin Oil & Refining Co. will complete a 1,500-bbl. per day hydrofluoric acid alkylation unit at Enid, Okla., by March 1958. Badger Manufacturing Co. has contract.

Cities Service Co. will build a $22,000,000 refinery at Toronto, Ont. Design will allow ready expansion from an initial 20,000-bbl. per day capacity. Plant will include two-stage atmospheric and vacuum distillation, fluid catalytic cracking, catalytic reforming, and hydrodesulfurization. C. F. Braun Co. of Canada, Ltd., is engineering contractor. Completion is set for November 1957.

Clark Oil & Refining Corp. will increase crude capacity 7,000 bbl. per day at Blue Island, Ill., by January 1, 1958. Capacity of vacuum unit charging topped crude will be increased 8,000 bbl. per day by September 1, 1957. By March 1, 1958, a 15,000-bbl. per day fluid catalytic cracking unit (50 per cent recycle) and a 1,500-bbl. per day sulfuric acid alkylation unit will be completed. The two units will cost $7,250,000. Procon, Inc., has contract.

THIS MAP shows the boundary lines selected for each area. A report on refinery construction will be made on one area each month.

Continental Oil Co. will complete a 3,500-bbl. per day catalytic reformer at Denver by August 1957. Refinery Engineering Co. has contract.

At Westlake, La., a 10,000-bbl. per day delayed coker will be completed by November 1957.

At Ponca City, Okla., an 11,000-bbl. per day catalytic reformer and a 16,000-bbl. per day hydrodesulfurization unit will be completed by July 1957. M. W. Kellogg is contractor for the reformer.

At Wichita Falls, Tex., a 3,500-bbl. per day catalytic reformer is being added at a cost of $1,500,000. Construction begins July 1957, with completion set for early 1958.

Cooperative Refinery Association will add a 3,500-bbl. per day Unifiner and a 3,500-bbl. per day Platformer at Phillipsburg, Kans., by December 1958. Cost is $1,250,000. Southwestern Engineering Co. has contract.

D

D-X Sunray Oil Co. will complete a 6,000-bbl. per day Unifiner at Duncan,

(Continued on page 134)

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Refinery Construction Report

(Continued from page 132)

Okla., in 1958. Refinery Engineering Co. is contractor.

At West Tulsa, Okla., a 12,000-bbl. per day Platformer, a 20,000-bbl. per day Unifiner, a 3,000-bbl. per day hydrofluoric acid alkylation unit, and 2,000-bbl. per day of butane isomerization will be added in 1958. Engineering and design are by Refinery Engineering Co. and U.O.P.

E

El Paso Natural Gas Products Co. will complete a 6,500-bbl. per day refinery near Gallup, N. M., by November 1957. It will include Platforming, fluid catalytic cracking, a vacuum unit, and a hydrofluoric acid alkylation unit. Engineering and construction are by Southwestern Engineering Co.

At Odessa, a 6,500-bbl. refinery and alkylation plant will be completed by April 1958. Its facilities will include crude, vacuum, catalytic cracking, gas concentration, Platforming, and hydrofluoric acid alkylation units.

F

Farmers Union Central Exchange will complete a 4,400-bbl. per day Platformer and a 12,200-bbl. per day Unifiner at Laurel, Mont., by March 1958. Cost is $3,000,000.

Frontier Refining Co. is increasing crude capacity 2,500 bbl. per day in two stages at Cheyenne, Wyo. Part of the increase was completed in February. Remaining increase, plus an 1,800-bbl. per day increase in straightrun asphalt capacity, will be completed by July 1, 1957.

H

Husky Oil & Refining, Ltd., plans crude expansion at Lloydminster, Alta., but plans are not complete.

Crude expansion and a new disulforming unit are planned for Fort William, Ont. A 250-bbl. per day oxidized asphalt unit will be completed July 1, 1957.

Crude expansion is planned for the Moose Jaw, Sask., plant, but plans are incomplete.

I

Imperial Oil, Ltd., will increase crude capacity 2,650 bbl. per day and fluid catalytic cracking capacity 1,500 bbl. per day (23 per cent recycle) at Winnipeg, Man., in 1957. A 3,150-bbl. per day Powerformer will be completed in October 1957. Foster Wheeler Corp. has contract.

At Calgary, Alta., plant capacity will be expanded to 18,500 bbl. per day.

J

Jefferson Lake Sulphur Co. plans a refinery just east of Calgary, Alta.

K

Kerr-McGee Oil Industries, Inc., will complete a 5,500-bbl. per day U.O.P. Platformer and a 4,000-bbl. per day U.O.P. Unifiner at Wynnewood, Okla., by July 1, 1958. Cost is $4,000,000. Refinery Engineering Co. has contract.

L

Lake Superior Refining Co. will increase crude capacity 3,500 bbl. per day, Platforming capacity 1,000 bbl. per day, and add a 4,300-bbl. per day Unifiner at Superior, Wis., by October 15, 1957.

M

McMurrey Refining Co. will increase Platforming capacity 5,200 bbl. per day and add a 3,200-bbl. per day Unifiner at Tyler, Tex., by June 1958.

N

Naph-Sol Refining Co. will increase crude capacity 3,500 bbl. per day at Muskegon, Mich., by October 1, 1957.

P

Panhandle Oil Co. will increase crude capacity 1,000 bbl. per day, fluid catalytic cracking capacity 500 bbl. per day (23 per cent recycle), catalytic polymerization capacity 150 bbl. per day, and add a 3,000-bbl. per day Platformer at Wichita Falls, Tex., by July 1957.

Phillips Petroleum Co. is building a 3,000-bbl. per day fluid catalytic cracker (63 per cent recycle) at Great Falls, Mont. Completion is set for summer 1957. Procon, Inc., has contract.

At **Sweeny, Tex.,** a 16,000-bbl. per day reforming unit and desulfurization facilities will be completed by January 1958. Cost is $4,000,000. Fluor Corp., Ltd., has contract.

At Woods Cross, Utah, a 3,700-bbl. per day catalytic reformer will be completed spring 1958. Procon, Inc., has contract.

Pure Oil Co. will add a 12,000-bbl. per day Sinclair-Baker catalytic reforming unit, and a 17,000-bbl. per day Kellogg unit at Lemont, Ill., by fall 1957. M. W. Kellogg Co. is contractor.

R

Regent Refining (Canada), Ltd., will increase crude capacity 20,000 bbl. per day, add an 8,000-bbl. per day vacuum unit for changing topped crude, add an 11,300-bbl. per day fluid catalytic cracker (61.5 per cent recycle), and add a 730-bbl. per day catalytic polymerization unit at Port Credit, Ont., by summer 1957. Engineering and design are by Procon (Canada), Ltd., and U.O.P.

Rock Island Refining Corp. will increase Platformer capacity 400 bbl. per day and Unifining capacity 4,600 bbl. per day at Indianapolis by August 1, 1957.

Royalite Oil Co., Ltd., will increase crude capacity 500 bbl. per day at Saskatoon, Sask., by August 1957.

S

Salt Lake Refining Co. will increase crude capacity 3,000 bbl. per day and capacity of vacuum unit charging topped crude 2,000 bbl. per day at Salt Lake City by June 1957. A 6,000-bbl. per day Platformer will be added by November 1957. Flour Corp., Ltd., has crude expansion contract.

Shamrock Oil & Gas Corp. will increase sulfuric acid alkylation 1,100 bbl. per day by fall 1957, at Sunray, Tex. Catalytic Construction Co. has contract.

Shell Oil Co. will complete a 12,000-bbl. per day Platformer at Norco, La., summer 1958. Contractor has not been announced, but Foster Wheeler Corp. and J. F. Pritchard Co. will build auxiliary facilities.

Sinclair Refining Co. will add a 7,500-bbl. per day Sinclair-Baker catalytic reformer at Hartford, Ill., by July 1, 1957. Arthur G. McKee & Co. has contract.

Sioux Oil Co. will increase crude capacity 500 bbl. per day at Newcastle, Wyo., by July 1, 1957.

Skelly Oil Co. will complete a 3,500-bbl. per day Phillips HF alkylation unit at El Dorado, Kans., by spring 1958. Engineering and construction will be handled by Skelly personnel.

Socony Mobil Oil Co., Inc., will complete a 9,000-bbl. per day catalytic reformer at Augusta, Kans., in August 1957. J. F. Pritchard Co. is contractor.

At Trenton, Mich., a 3,500-bbl. per day sulfuric acid alkylation unit will be completed in December 1957, by Fluor Corp., Ltd.

At Casper, Wyo., a 3,000-bbl. per day catalytic reformer and a 3,250-bbl. per day hydrodesulfurization unit will be completed in November 1957, by J. F. Pritchard Co.

Standard Oil Co. (Ind.) is adding a 6,000-bbl. per day Ultraformer and a 6,000-bbl. per day Hydrofiner (Ind. Standard) at Neodesha, Kans. Completion is set for January 1, 1958. Foster Wheeler Corp. has contract.

At Whiting, Ind., Ultraforming capacity will be increased 21,000 bbl. per day and Hydrofining capacity 21,000 bbl. per day by early 1958. Ralph M. Parsons Co. has contract for the Ultraformer.

Standard Oil Co. (Ohio) will complete a 3,500-bbl. per day sulfuric acid alkylation unit at Cleveland by May 1, 1958. Arthur G. McKee & Co. has prime contract. Cost will be $3,400,000.

At Toledo, construction is under way to replace present crude, thermal processing, and polymerization units. Crude capacity will be 60,000 bbl. per day, capacity of vacuum unit to charge topped crude 23,000 bbl. per day, polymerization capacity 1,650 bbl. per day, and delayed coking 8,000 bbl. per day to produce 350 tons per day of coke. Units being added to the plant include a 55,000-bbl. per day fluid catalytic cracker (45 per cent recycle), a 12,000-bbl. per day Sinclair-Baker catalytic reformer, and a 22,500-bbl. per day Kellogg Hydrofining unit. Completion is set for April 15, 1958. M. W. Kellogg Co. has prime contract. Project will cost $40,000,000.

Standard Oil Co. of Texas will increase crude capacity 28,000 bbl. per day, and capacity of vacuum unit charging topped crude 13,200 bbl. per day at El Paso, Tex. A 13,500-bbl. per day fluid catalytic cracker, and a 2,025-bbl. per day catalytic polymerization unit will be added. Completion is set for February 1958. Fluor Corp., Ltd., has contract for the catalytic cracker

T

The Texas Co. will increase both Platformer and Unifiner capacities 10,000 bbl. per day at Lockport, Ill., by October 1, 1957.

W

Wainwright Producers & Refiners, Ltd., will complete a 3,000-bbl. per day gas-oil cracking unit at Wainwright, Alta., by fall 1957. A 600-bbl. per day Platformer, a Unifiner, and a 50-bbl. per day catalytic polymerization unit are also planned for 1957.

Westland Oil Co. will complete a 1,000-bbl. per day gas-oil cracking unit at Williston, N. D., by June 1957, and increase Platforming capacity 600 bbl. per day by September 1957.

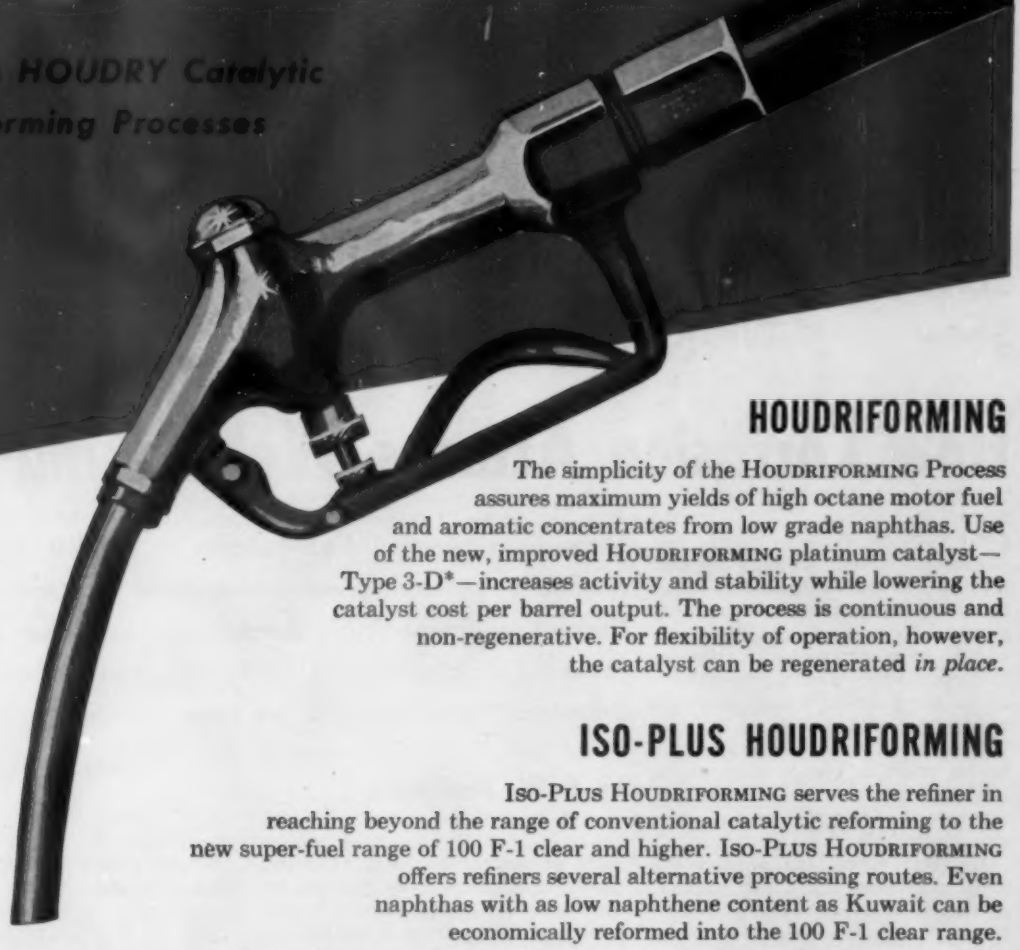
Wickett Refining Co. will complete a 1,000-bbl. per day Catformer and a 1,000-bbl. per day Unifiner at Wickett, Tex., by October 1, 1957.

Low Grade NAPHTHAS

to

High Octane GASOLINE

with HOUDRY Catalytic Reforming Processes



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The simplicity of the HOUDRIFORMING Process assures maximum yields of high octane motor fuel and aromatic concentrates from low grade naphthas. Use of the new, improved HOUDRIFORMING platinum catalyst—Type 3-D*—increases activity and stability while lowering the catalyst cost per barrel output. The process is continuous and non-regenerative. For flexibility of operation, however, the catalyst can be regenerated *in place*.

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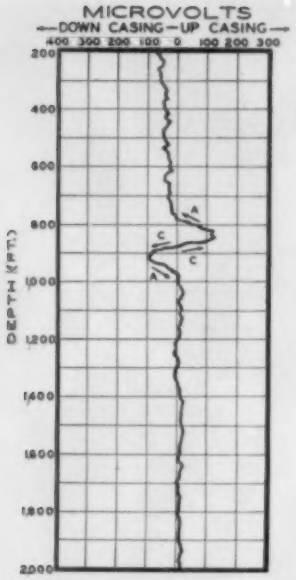
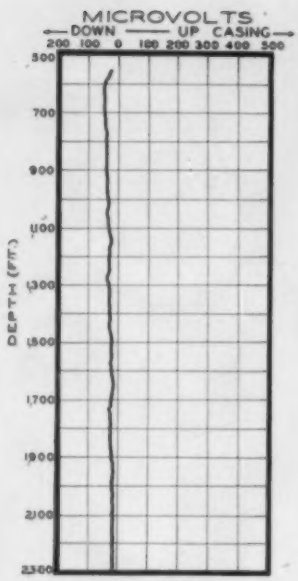
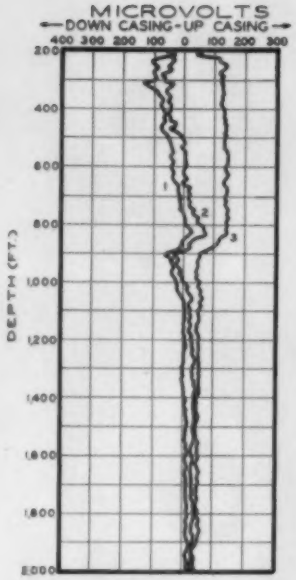


POTENTIAL-DROP PROFILE: anodic areas marked A, cathodic areas marked C. Fig. 1.



POTENTIAL-DROP of well undergoing external corrosion due to bacterial action. Fig. 2.



PROFILE shows: (1) flow line connected, (2) insulated, and (3) cathodically protected. Fig. 3.

How Corrosion Attacks Well Casing

Cathodic protection has become a reliable and useful method of protecting well casing from external corrosion. Current requirements are determined from either downhole potential-drop surveys or wellhead-current-potential measurements. Here is how to use these methods.

by Y. W. Titterington

CORROSION of the external surfaces of casing, in both oil and gas wells, is now recognized by many producing companies to be a major problem. Holes in casing, due to corrosion, have necessitated costly repair operations, reduced productivity, or in many cases, forced abandonment of the well.

The corrosion of well casing may be the result of one or more of the following factors; galvanic action, sulfate-reducing bacteria, or stray-current electrolysis.

Galvanic action can produce the most pronounced effect. For example, in certain areas of western Kansas, casing leaks often occur within 8 months to a year after the well is completed.

Such corrosion is usually attributed to the presence of Dakota brine, and differences in salt content of adjacent formation strata. As a result, the potential between the casing and the formation will vary, from one stratum to the next. These differences in potential result in current flow from one section of casing to another, through the formation. The current flows from the casing in areas where the casing is more negative, with respect to the formation.

Corrosion will take place at such areas of current discharge. The intensity of attack will be greatest in the vicinity of abrupt changes in potential, resulting from a change in environmental conditions. Such corrosion is often intensified by the occurrence of oxygen concentration cells between the casing and surface piping or tank bottoms.

Author is president, Corrosion Services, Inc., Tulsa and Sand Springs, Okla.

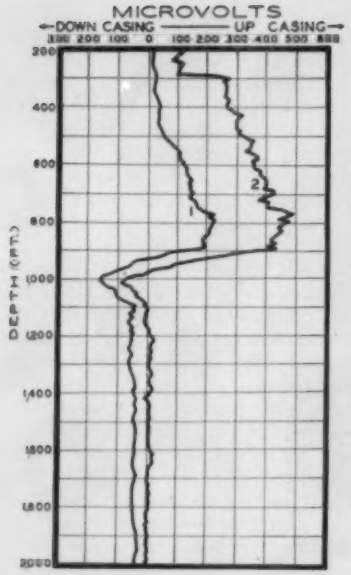
Potential Profile Surveys

For a number of years, operators have been using a potential-drop survey[1] to determine the probability of external casing corrosion. A typical down-the-hole potential-drop profile is shown in Fig. 1. As indicated on the curve, the gross anodic, or most severely corroding areas are marked "A", while the cathodic section, or area of major current pickup, is marked "C".

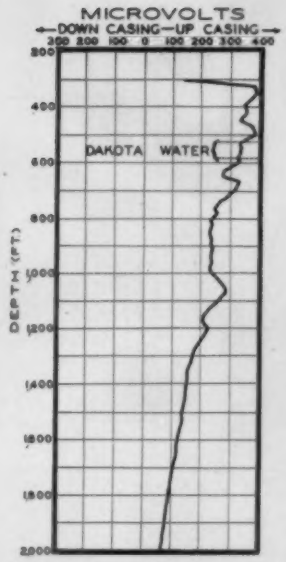
Where anaerobic sulfate-reducing bacteria are the causative agent, gross anodic areas, as indicated by sharp breaks in the potential-drop curve, usually do not occur. Such a curve, in an area characterized by casing failures due to bacterial action (as established by visual inspection of pulled casing) is shown in Fig. 2.

In some instances, the absence of sharp breaks in the curve has been interpreted as an indication of relative freedom from external casing corrosion. Such conclusions can only be validated by a visual inspection of the casing or, if casing perforation has occurred, evidence by caliper survey that the trouble is due to internal corrosion.

Admittedly, such surveys cannot be used as a quantitative measure of the corrosion taking place. The in-



PROFILE of well (offset to well in Fig. 3): (1) flow line connected, (2) flow line insulated. Fig. 4.



POTENTIAL-DROP profile of well after 3 months of cathodic protection. Fig. 5.

terpretation should be based on general trends, rather than the relative values of individual points. The anodic or corroding areas are denoted by a negative slope (loss of current), and the cathodic or passive areas by a positive slope.

Making the survey . . . In this method of surveying, the following factors play an important part in obtaining valid data:

1. Insulation of the well from all other metallic structures.
2. Polarity of contactors.
3. Resistance between contactor heads.
4. As close a spacing between contactor heads as is economically feasible (10 or 25 ft.).
5. Sharp knife-edged contactors.
6. Sufficient tension on contactors that tool will support its own weight.

Caution should be exercised to assure that the contactors are cutting through any scale, and contacting bright metal. Extremely high values or lack of reproducibility are an indication of poor contacts. Another factor which may result in erroneous data may be relatively high resistance across collars. Joints of different weight pipe also should be located for proper interpretation of surveys.

Cathodic Protection

If corrosion is electrochemical it can be stopped by increasing the cathode potential (polarization) to a value equal to or greater than the open-circuit potential of the anodes. (Current required to do this depends upon whether the cathodic polarization is large or small, compared with the resistance drop.)

In practice this is done by supplying the required current from a ground bed located a minimum distance of 100 ft. from the well. Many investigators have checked the current distribution along the casing with ground beds located at various distances and find that little is to be gained by increasing this distance.

Where ground beds are closer than this, however, the depth to which the protective current is projected is decreased. This phenomenon provides a means of reducing the total current requirement where protection is sought for relatively shallow depths only. It is now possible to determine current requirements to any desired depth by proper placement of the standard half-cell, when running the current-potential curves.

This in no way assumes that complete protection is obtainable to total depth. Where massive anhydride or salt sections are present, the protective current usually cannot be projected below such high-resistivity media. Neither increases in applied current nor the effect of polarization will improve this condition.

Current requirements . . . Normally, a much lower current density is required for the protection of well casing than would be required for the same size and length pipeline. This difference is due primarily to the absence of oxygen in the formation in contact with the vertical casing, resulting in greater ease of polarization.

This is consistent with experience in the cathodic protection of pipe lines. Current density requirements are lower for pipe deeply buried in heavy soils, than pipe buried at more shallow depths or in more porous soils.

The fundamental principle involved is that in an essentially oxygen-free media, usually only a relatively small portion of the structure is anodic. As a result, only enough current is needed to equal that producing free corrosion. (This condition applies, however, only when the structure is under cathodic control.) In addition, due to the absence of strong oxidizing agents, chemical polarization resulting from the deposition of hydrogen and/or carbonates, quickly reduces the current requirement by building up a partially protective film.

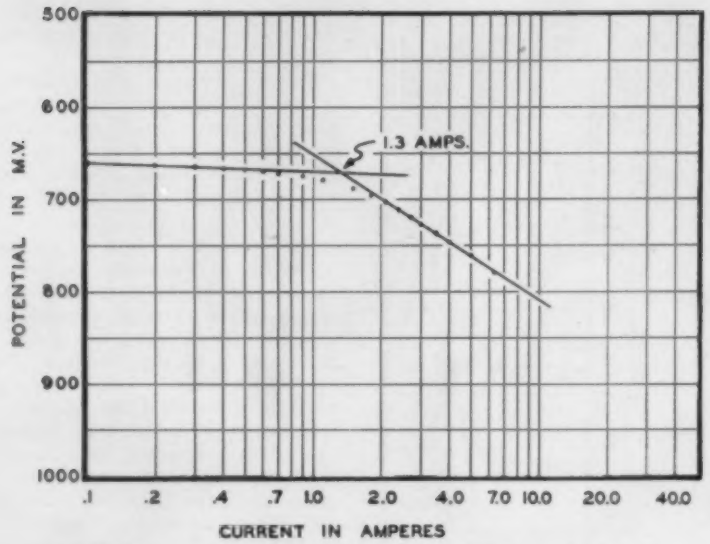
In many instances, the solution potential of wells to remote earth, which had been changed by from 75 to 300 mv. with the application of the equivalent of 1.27 amp.-hr. of current, required several days to drop back to its original value.

Of particular interest is the fact that the current requirements usually vary widely in the same field, often between adjacent wells. This is true even though well conditions (i.e., total depth, completion practice, type of mud used, etc.) are apparently the same.

Range required . . . By way of illustration, in one small field on the central Texas Gulf Coast, the current requirements ranged from 1.1 to 6.2 amp. Total depth of these wells was approximately 5,500 ft. In western Kansas, the range is often from 0.5 to 0.3 amp. between adjacent wells.

A classic example of this difference may be seen by comparison of Figs. 3 and 4. In Fig. 3, curves 1 and 2 are potential-drop profiles of the casing in the native state with the flow line connected and disconnected; whereas, curve 3 shows the net effect of applying 1.24 amp. of current from an anode bed located approximately 150 ft. from the well.

Fig. 4 shows potential-drop profiles run on an adjacent well located but a few hundred feet distant, having a difference in elevation of only 7 ft. At the time this latter well was checked, 1.3 amp. of current had been applied for a 2-month period. After run No. 1 was completed, it was found that the insulation between the flow line and the well head had failed. Run No. 2 was then made



TYPICAL current-requirement curve run on an Oklahoma well. Fig. 6.

with the flow line disconnected from the well.

It is obvious that the current requirements for these two wells were considerably different. Whereas 1.24 amp. was sufficient to meet the initial current requirement for the well given in Fig. 3, considerably more than 1.3 amp., even after 60 days, would be required to protect the well casing in Fig. 4. This is indicated particularly by the remaining anodic areas at 300 to 750 ft. and 1,000 to 1,100 ft. Incidentally, a casing leak occurred in this latter well 2 years after current was applied.

Change in current . . . Reduction of the current requirements with time is a function of the degree of chemical polarization. That this phenomenon can exert considerable influence is indicated by Fig. 5. This profile, run on a well in the Dakota water area of Kansas, shows the effect of 0.9 amp. of current some 3 months after the initial current requirement of 1.3 amp. had been applied.

The amount of current pickup down to 2,000 ft. and the resulting uniform pickup through the Dakota water section are significant. This profile is in direct contrast to a typical profile run immediately after current was applied on another well in the immediate vicinity (Fig. 3, curve 3).

A study of Fig. 5 may lead to the conclusion that several anodic areas still exist above 1,050 ft. These anomalies, however, are probably inconsequential as the casing was heavily scaled throughout this section and the electric logs indicated no noticeable change in formation characteristics at these depths.

It is felt that a different situation prevails in areas like Hugoton field where bacterial action is believed to be the causative agent of corrosion. Here, mere polarization of the casing may not suffice. Protection in this case is achieved by maintenance of an alkaline environment around the casing. This condition can be maintained at any given area only by a flow of current through the electrolyte onto the metal surface. Thus, although polarization can materially reduce the current requirements where galvanic action is involved, it is doubtful whether it can be relied upon to permanently arrest bacterial action.

Polarization Potential Curves

In addition to the standard casing potential-drop profile method of determining current requirements, increasing reliance is being placed on the log-current potential method[2]. The latter method consists of making a semilog plot of the solution potential of the well to remote earth at increasing increments of applied current. Such a curve is shown in Fig. 6.

In theory[3], and confirmed by laboratory and field tests[4], if the corrosion of an iron structure surrounded by an electrolyte is under cathodic control, its potential (referred to a standard half-cell remotely located in the electrolyte) will remain constant with increasing values of applied current, until sufficient current is applied to prevent corrosion. After this value has been reached, the structure will act as a hydrogen electrode and the potential will vary linearly with the logarithm of the applied current. The point of intersection of the two straight-line portions of the curve should give the value of the minimum current required for protection.

Where cathodic control is incomplete (a condition of mixed control) the curve for low current densities will not be horizontal but have some slope[5]. Also, if cathodic control fails gradually, the curve will bend.

The explanation of the horizontal portion of the curve is that the cathodic areas are large compared with anodic areas and thus determine the potential of the casing. The potential did not change as all of the current entered the anodic section, counteracting the corrosion current from the anodes.

This unequal distribution of current is due to the relatively low resistance of the formation surrounding the casing at the anodic areas. Any curvature between the horizontal and sloping portion of the curve represents the transition to the overvoltage curve. This distribution of current with resultant potentials is consistent with the basic principles of cathodic protection.

Correlation of results . . . Early measurements of this type on well casing, while giving consistent results in any given field, required the use of a correction factor in order to correlate them with results obtained by the potential-drop method. The instrumentation developed for this test by the writer some 2 years ago gives excellent correlation as run. This instrumentation is shown schematically in Fig. 7. A recent refinement of this apparatus utilizes a motor-driven vibrator to make and break the current circuit. This permits standardization of the test procedure, as the potential is always read with the same period of discharge of the condenser. In addition, this period of discharge is limited to a small fraction of a second.

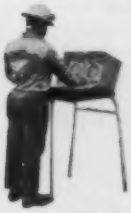
The usual procedure for making such a test requires first that the well be electrically isolated from all other metallic structures. Current in small increments is then applied for periods of from 2 to 5 minutes. At the end of each time interval, the circuit is momentarily broken and the well-to-soil potential immediately measured.

The time the circuit is open is extremely critical if smooth, sharp curves are to be obtained. It cannot be stressed too strongly that the success of the test is dependent upon the operational technique. An equally important factor is the location of the half-cell. It should always be as far removed as possible from any foreign structures consistent with the depth of casing to be protected, and

Dowell engineer controls the powerful Allison with remote panel.

MUD ACID

gives frac jobs a running start



For best results, fracturing fluid must enter the pay zone with enough velocity to carry its cargo of sand deep into the formation. Often, when the sand-laden fluid enters a "mudded off" formation, fluid velocity is decreased and the sand is "screened out" in the well bore. The result may be a poor fracturing job.

This situation can be avoided by using Mud Acid as a spearhead for fracturing. Mud Acid, a combination of hydrochloric and hydrofluoric acids, has the ability to dissolve or disintegrate drilling mud materials, such as bentonite. This permits fracturing fluids to enter the formation at reduced pressures and higher velocities. It also provides better distribution of the sand and increased permeability in the critical area surrounding the well bore.

Versatile Mud Acid is also used to open mud-fouled screens and liners and to free stuck drill pipe. It is an effective spearhead to clean up the well ahead of squeeze cementing operations.

For more information on the many uses of Mud Acid, call any of the 165 Dowell offices in the United States and Canada; in Venezuela contact United Oilwell Service. Or write to Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

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so as to allow as unobstructed vision of the well as possible.

Application of Cathodic Protection

The protective current required to mitigate external casing corrosion may be supplied from the d.c. current source, namely: magnesium anodes, rectifiers or generators.

In designing a magnesium anode installation for any predetermined current output, the following factors must be carefully determined: Well-to-earth potential; well-to-earth resistance; soil resistivities.

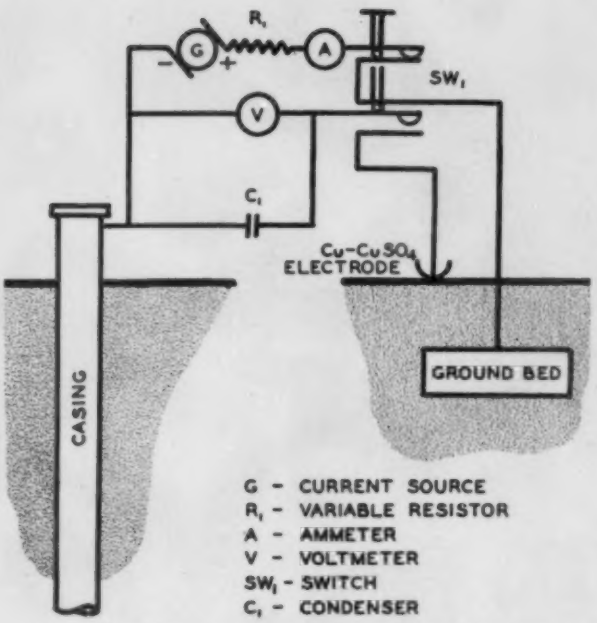
After these three factors are known, it is relatively simple to determine the most economical size of anode, the quantity of surrounding backfill, and the ground-bed configuration. Practical limitations for magnesium anodes are of the order of 2.1 amp. in 4,000 ohm-cm. soil and 4.65 amp. in 1,000 ohm-cm. soil. Such installations can be designed so precisely that hundreds of wells have been placed under protection based on prior quotations guaranteeing anode current outputs.

In the past, most operators used a standard procedure of installing either five or six magnesium anodes in the far extremities of the reserve pit. In many instances, the resulting current outputs were very disappointing and made many operators believe that magnesium anodes were not suitable for this application.

This erroneous conclusion is understandable, for a survey of anode current output data involving several producers in Kansas showed a current range of from 200 to 1,700 ma. The average of some 200 wells was less than 600 ma. Considering just one of the design factors, a variation of 0.1 to 0.5 ohms in well-to-earth resistance could account for a range of 1,500 to 860 ma.

These early installations were initiated in 1949 on an experimental basis. It was believed that if external corrosion leading to perforation of casing could be delayed for 2 years or more, it was well worth the average installation cost of $160. At the same time it would serve to prove or disprove the merits of the system.

Unfortunately, even though the limitations of this type of application are now recognized, many operators still employ this standard installation for every well, regardless of individual well requirements. With the new tools and techniques developed and perfected within the past 2 years for determination of current requirements, the economics of the application demand the absolute necessity of engineering each well on an individual basis. Designing for the average or maximum condition has already led some operators to the belief, either that cathodic protection will not stop external casing corrosion, or that the application is not economical.



CIRCUIT DIAGRAM for log-current potential method. Fig. 7.

Better design . . . Using new types of anodes and a special range of new anode lengths, the economical application for magnesium anodes to well casing has been greatly extended. In general, the shorter anodes are more economical in low resistance soils; whereas the longer anodes provide lowest installation expense in high-resistance soils. Costs for such installations range from $140 to $600, based on a 10-year life.

Design of a rectifier installation is comparatively simple, because of the higher potential of the current source and the flexibility of control. However, this higher potential, unless controlled to reasonable values, may prove disadvantageous in the form of stray-current electrolysis of foreign structures.

The tendency in many instances is to choose the system with the cheapest initial installation costs, utilizing a one-electrode ground bed and a 30 to 60 volt rectifier. While it is true that any impressed current may result in corrosion of foreign structures, a higher potential or driving force may affect more structures or cause them to pick up more current. This effect can be minimized by the use of larger ground bed installations which require less potential difference to give the required current flow.

It is recommended that such installations should be designed on the basis of a 10-volt maximum current source. Unless all of the structures in the field are to be protected, an individual rectifier should be installed on each well, with the current restricted to the minimum amount required for protection.

Stray current . . . Recent field investigations suggest the possibility of accelerated corrosion of well casing by pipeline rectifiers, and vice versa. On occasion such current has been detected, coming from units located several miles away. Unfortunately, no surface test is yet available that can be relied on to quantitatively measure the amount of stray current involved. The only reliable method is to run comparative down-the-hole potential-drop surveys with the rectifiers in the area off, and with them on.

References

1—Ewing, S. P. & Bayhi, J. F., "Cathodic Protection of Casings in London Pool," Corrosion, Vol. 4, No. 6, June 1948, p. 264.

2—Barrett, J. P. and Gould, E. D., "Cathodic Protection in Action," World Oil, March 1956.

3—Ewing, Scott, "Determination of The Current Required for Cathodic Protection," presented at the American Gas Association Distribution Conference, Houston, Texas, May 7-9, 1940.

4—"Underground Corrosion," National Bureau of Standards, Circular C450, p. 254.

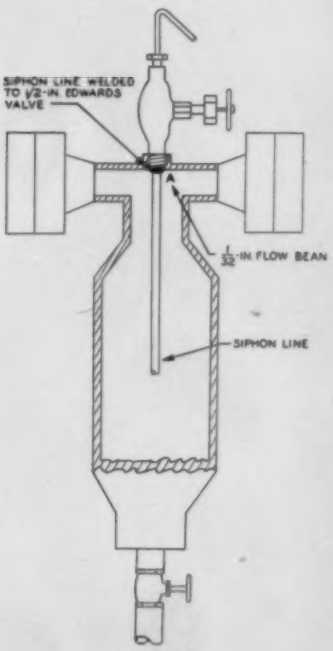
5—Koger, W. C., "Casing Corrosion Hugoton Gas Field," presented at NACE Conference, New York, N. Y., March 12-16, 1956.

Mud pits marked with weld metal

A W. THOMPSON'S new deep-hole Rig 1 has its mud pits marked for sure and easy reference. The total capacity of the pit shown is put on the side with weld metal. Also the number of barrels of mud for each foot of pit depth is marked. Therefore, there will never be a question on this rig when mud-missing calculations are made.

Portable shelf holds sucker-rod wrenches

THE platform shown here is used by H. H. Smith, pulling-machine operator for H. R. Gregory of Lea, N. M., to lay sucker-rod wrenches on when rods are pulled. As soon as the polish rod is removed, the platform is stripped up over the first sucker rod and then set down into the tubing collar. This speeds up rod handling considerably and prevents tiring of the rod-wrench handler as he can lay the tools down between joints.

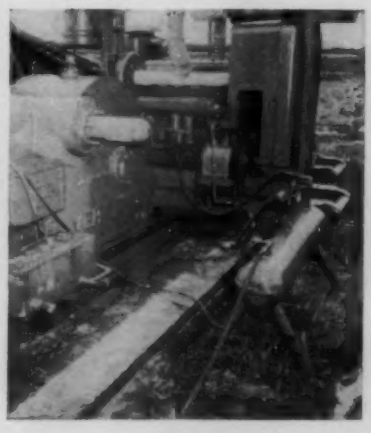


Edwards needle valve used for siphoning

A SIPHONING arrangement can be used to obtain water samples of a flowing well without shutting in the well. The method consists of welding a ½-in. nipple to the male end of an Edwards needle valve and then screwing this into the existing ½-in. tap of the sample-bottle tee.

The 1/32-in. flow bean at point A permits full opening of the needle valve and water will pass through the siphon line. The likelihood of of sand's stopping up the valve is greatly reduced by this method and likewise the tendency for sample valves to freeze up is reduced because the warm flow stream passes over the sample line.

Compressor provides rig with air supply

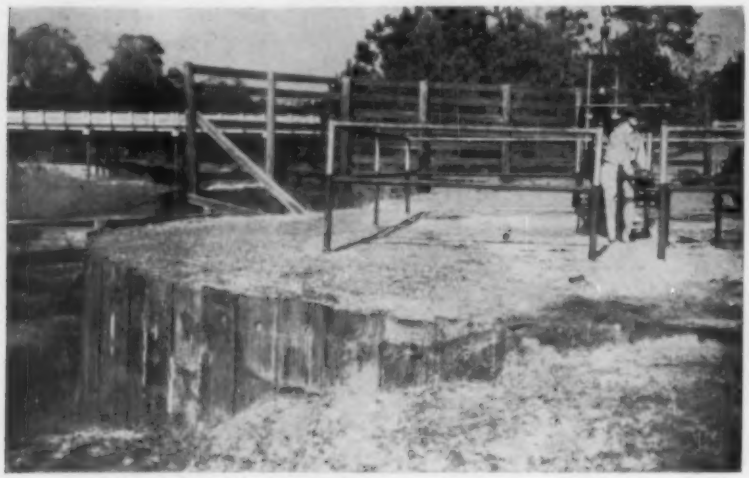


A SIMPLE means of supply air for starting engines, operating lubricating systems on mud pumps, and use on the rig floor has been devised by Pronto Drilling Co. of San Antonio, Tex.

A small compressor is mounted on the side of the engine skid and a V-belt run to a sheave on the front of the crankshaft. The outlet from the compressor is then connected to a horizontal vessel.

The outlet to the starting motor, mud-pump lubricator, and the engine floor are then connected to the top of the chamber which scrubs the air and provides a surge chamber for storage.

ON THE JOB . . . . . IN THE FIELDS



Creek-bank piling protects well site

. . . steel sheeting may be used

WHEN a well must be drilled along a creek bank, a retaining wall easily can be constructed by driving interlocking sheet piling around the location. After the rig is moved, the piling will last the life of the well and prevent damage by the stream.

On the location shown here in Conroe field, Montgomery County, Texas, a few hours with a drag line and an air hammer set the piling in place. The inside of the circle was then filled with clay to make a foundation for the rig and a level location. If the well should be abandoned, the piling can be pulled.

Aluminum pipe steps up installation by 78 hours

DELTA GULF DRILLING CO. cut installation time by 78 hours by laying this aluminum gas line rather than conventional steel pipe. A crew of six men laid 10,000 ft. of the 2½-in. aluminum pipe in 3 hours. The same crew was averaging 5,000 ft. per 8 hours when laying 30-ft. sections of conventional tubing.

The well on which Delta Gulf used the aluminum pipe was the 2 Powell near Kinder, La. Delta Gulf was drilling for General American Oil Co. The pipe carried gas from a main line 2 miles away to the rig.

Victaulic snap-joint couplings used with the pipe permitted fast make-up. The low weight of 30 lb. per 30-ft. joint speeded handling. The light weight is an important factor in pipe laying in this area because the terrain requires that pipe be brought in by hand, in many cases.

ELEMENTS OF FIELD PROCESSING—34

Calculation of the Compressibility Factor Z

By Dr. John M. Campbell

THE compressibility factor Z offers an accurate and yet convenient method of determining the P-V-T properties of an actual gas according to the equation:

$$PV = ZnRT \qquad (1)$$

The Law of Corresponding States (Part 33), although not an exact one, further offers a satisfactory method of preparing a general correlation. Such a correlation of course is not entirely rigorous for it will vary slightly with the gas, but the error is substantially less than the error present in the engineering calculations in which the resultant value of Z is incorporated.

Figs. 1 and 1a are correlations for finding Z from the work of Nelson and Obert[1] and are based on data from 30 common gases, including those components present in natural gas. Consequently they are applicable to most gas P-V-T problems.

Example: Determine the value of Z for 0.6 specific gravity gas (T_c = 360° R., P_c = 672 psia.) at 80° F. and 500 psia.

Solution:

$$P_r = \frac{500}{672} = 0.744$$

$$\text{and } T_r = \frac{80 + 460}{360} = 1.5$$

From Fig. 1, **Z = 0.935** by interpolation.

Reference

1. Nelson, L. C., and Obert, E. F., Chem. Eng., pp. 203-08, July (1954).

Author is chairman, school of petroleum engineering, University of Oklahoma, Norman.

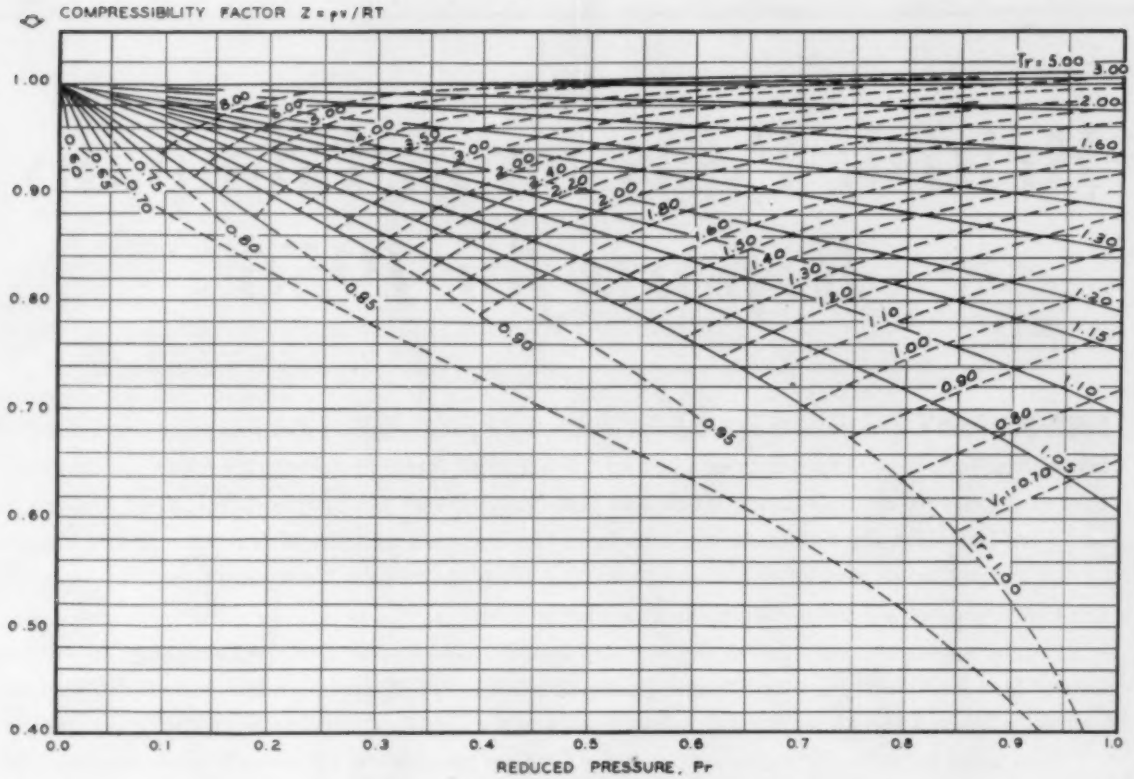


Fig. 1—Compressibility factors in the low pressure range.

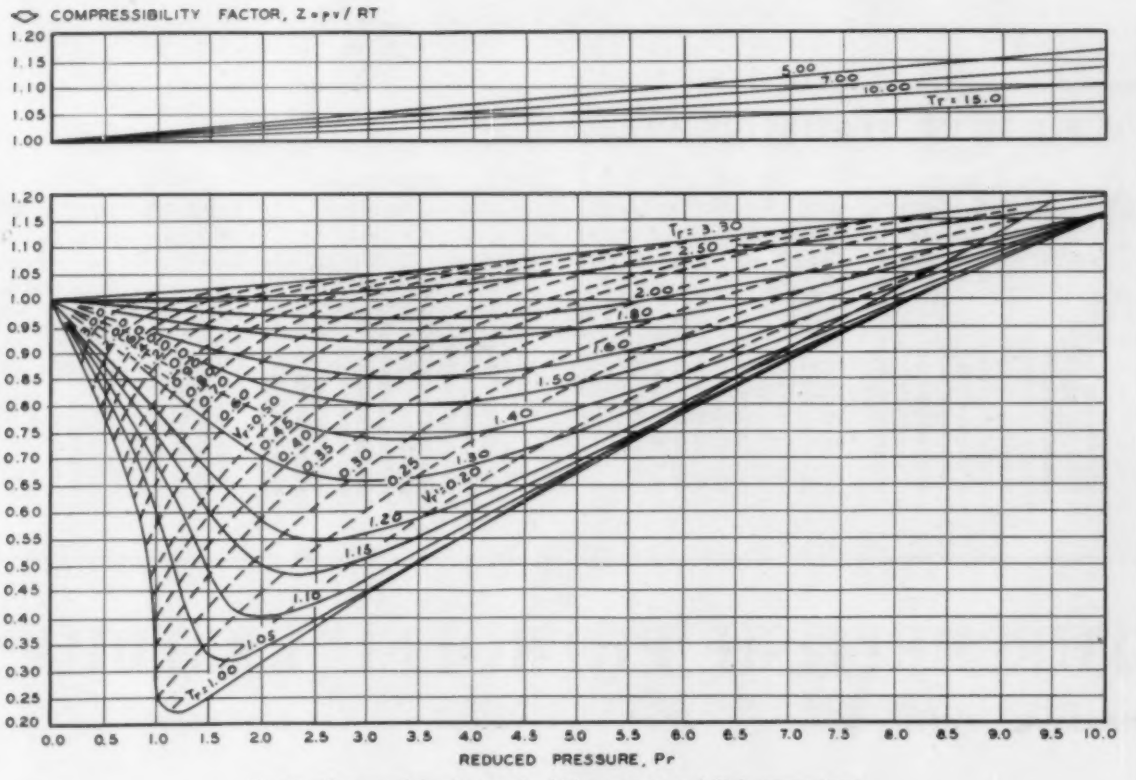


Fig. 1a—Compressibility factors for high pressures and high temperatures.

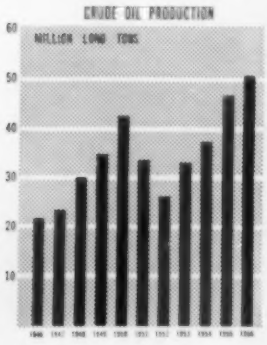
British Petroleum Company
Reports for 1956

British Petroleum's group sales of crude oil and refined products in 1956 rose to a new record of 53 million tons—an increase over 1955 of 11 per cent. After providing for taxation, depreciation and interest on debenture stock the consolidated net profit rose from £45 million to £53 million. But for the retarding effects in the last two months of the year of the closure of the Suez Canal, and of the damage to the Iraq Petroleum Company's pipeline system, BP's business would have expanded at a higher rate.

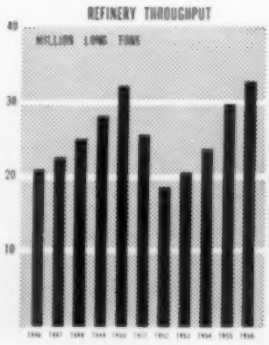
It is the intention, as stated at the last Annual General Meeting of the Company, to publish yearly and half-yearly group income statements; the first of these for the year 1956 appears below and shows the summarized trading figures of the Company and its Subsidiary Companies.

The initial half-yearly statement, for the first six months of 1957, will show comparative figures for the corresponding period of 1956, but it will be appreciated that the income in the current half year will be affected by the adverse conditions referred to above.

B. P. GROUP STATISTICS 1946-56



Crude oil production by BP last year was 1,017,000 barrels daily, or 82,000 more per day than in 1955. But for the curtailment of Middle East production in the last two months of the year, this increase would have been substantially greater.



Refinery throughput at BP's 14 refineries during 1956 was 668,000 barrels daily, an increase of 62,000 barrels per day over 1955. Plans for new refineries in Canada and Germany have been announced.

THE BRITISH PETROLEUM COMPANY

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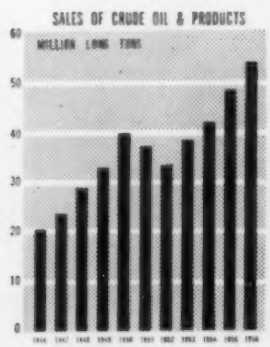
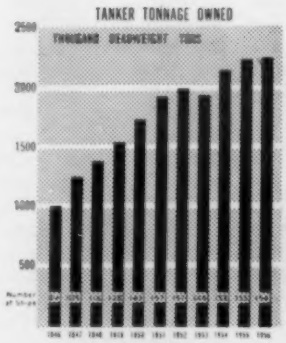
THE BRITISH PETROLEUM COMPANY LIMITED
GROUP INCOME STATEMENT
FOR THE YEAR ENDED 31st DECEMBER, 1956

		£
Sales Proceeds		721,633,000
Deduct: Sales Taxes, Customs and Excise Duties, etc.		174,333,000
Net Sales		547,300,000
Dividends and Other Income		10,327,000
		557,627,000
Cost of Oil, Operating, Selling and Administration Expenses	£381,480,000	
Depreciation and Amounts Written Off	37,288,000	
Interest Payable	2,578,000	
		421,346,000
		136,281,000
Taxation: United Kingdom and Overseas		79,631,000
		56,650,000
Deduct: Income applicable to Minority Shareholders		456,000
Net Income for the Year		£56,194,000
Attributable to: Consolidated Companies	52,718,000	
Non-Consolidated Companies	3,476,000	
		£56,194,000



Sales of crude oil and refined products in 1956 reached a record high of 1,089,000 barrels daily, an increase of 11% over 1955. This increase was almost equally divided between crude oil and refined products.



BP's tanker fleet consists of 154 ships totalling 2,258,000 deadweight tons. An additional 3,000,000 tons are on charter. Forty new tankers are due for completion during the next three years.

LIMITED

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How They're Reducing San Juan Basin Fracturing Costs

● Costs for stimulating wells by fracturing in the San Juan basin are coming down. Principal cost reducers are use of water for fracturing and use of perforation sealers for stage treating. Fracturing of the basin's gas sands with water has been extremely successful.

By Ewell N. Walsh

RECENT completion practice for wells in the San Juan basin, located in Northwest New Mexico and Southwest Colorado, is to set production casing through the producing formations, perforate, and fracture. Fracturing with water is very satisfactory both with and without sand. Use of rubber balls to plug off perforations that break down first has sharply reduced the need for straddle packers or bridge plugs to fracture-treat multiple zones.

Earliest well-stimulation method in the basin was solidified nitroglycerin. In 1953, fracturing with diesel oil and sand began. Both methods treated open hole. Later casing was set through producing sections, was perforated, then fractured with oil and sand. Use of water and sand started in August 1955. Water and sand first was used on the Mesaverde formation with no detrimental effect, then use spread to the Pictured Cliffs formation. In August 1956 fracturing with water only, began in some treatments of the Mesaverde formation.

Mesaverde

The Mesaverde formation is the major producing formation in the San Juan basin. Its average depth ranges from 4,500 to 6,500 ft. The formation consists of three members, the upper member of which is the Cliff House, the middle member the Menefee, and the lower member the Point Lookout. Of these, the two most productive are the Cliff House and the Point Lookout. The Menefee is productive only in some areas. Wells are drilled with gas circulation.

Picking zones . . . The first thing to be done before well fracturing is to choose the zones to be fractured. In the Mesaverde these zones are chosen from the interpretation of radioactive logs that have been made before the running of the production casing. The two methods used by the operators in the basin are the interpretation from gamma ray-induction logs made in conjunction with the open-hole temperature survey, and from the gamma ray-neutron logs made in conjunction with the double neutron or multispace log.

The first of these two methods uses the gas-entry point from the sands into the well bore, as determined from the open-hole temperature survey, in choosing the perforations. The second method uses the best sand section and possible dry-gas zones as determined from the multispace log in choosing the perforations. Both are accepted methods by the operators in the basin and are satisfactory for the fracturing methods used.

Completing . . . After the selection of the zones to be perforated, the Mesaverde zones are perforated with two to six holes per foot. Both bullets and jets are used with equal frequency, and sometimes combinations of the two are used. Four to six pump trucks are used to fracture, depending upon the horsepower and injection rates desired. Between 60,000 to 150,000 gal. of water for the fracturing are stored in steel or collapsible tanks on location.

Rotary tools are used to set casing and, if necessary, to clean cement out of the casing before the fracture treatment. Also the rotary tools are used after the treatment, using natural gas, to blow water from the well bore and drill up bridge plugs when used.

Author is with El Paso Natural Gas Co., Farmington, N. M. Paper presented at the 1957 spring meeting of the Southwestern District, A.P.I. Division of Production, Dallas, under the original title, "Water Frac in the San Juan Basin."

PRODUCING

Use of water as a medium for carrying the sand is in itself a great change in the type of fracture treatment previously used in the basin. Since the first use of water, the procedure used in fracturing has changed considerably.

At the time water was first used, the different members of the Mesaverde were fractured separately, sometimes using two different stages on one member. This is done by perforating the zones of the members and fracturing them separately with 40,000 to 60,000 gal. of water and an average of 1 lb. of sand per gallon of water.

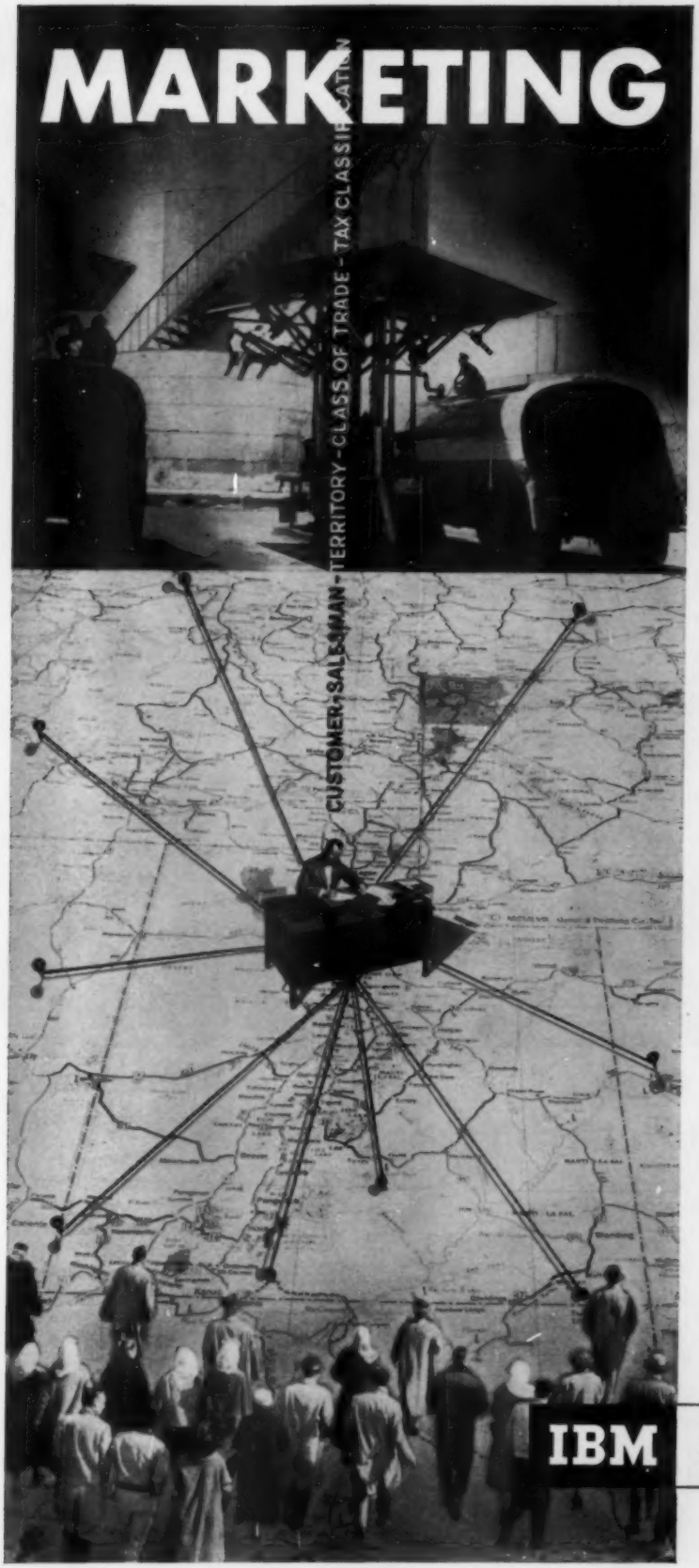
The Point Lookout has been fractured by the multistage method more often than the other two members of the Mesaverde. In most cases the type of sand used in fracturing the Point Lookout is 20 to 40-mesh (medium) sand. There are a few cases where a larger-grain sand, the 10 to 20-mesh (coarse) was used, but the coarse-grain sand had more of a tendency to cause a sandout or plugging of the formation.

Average treating or injection pressures of the Point Lookout members, fractured in one or two stages, will range from 1,500 to 2,200 psi. The average injection rates will range from 45 to 65 bbl. per minute.

The size sand generally used in fracturing the Menefee is 20 to 40-mesh (medium) grain. The injection pressures will range from 1,000 to 2,000 psi. and the injection rates from 40 to 60 bbl. per minute.

The 40 to 60-mesh (fine) and the 20 to 40-mesh (medium) grain sands have both been used in the Cliff House. There are a few cases in which there was a sandout in using the medium-grain sand; therefore, the fine-grain sand is prevalent in the Cliff House treatment. Average injection pressures for the Cliff House normally range from 1,700 to 2,300 psi. and the average injection rate range from 40 to 60 bbl. per minute.

In fracturing the members of the Mesaverde, the sand-water ratio is normally kept low until constant injection pressure is obtained. At that time the ratio is increased to the



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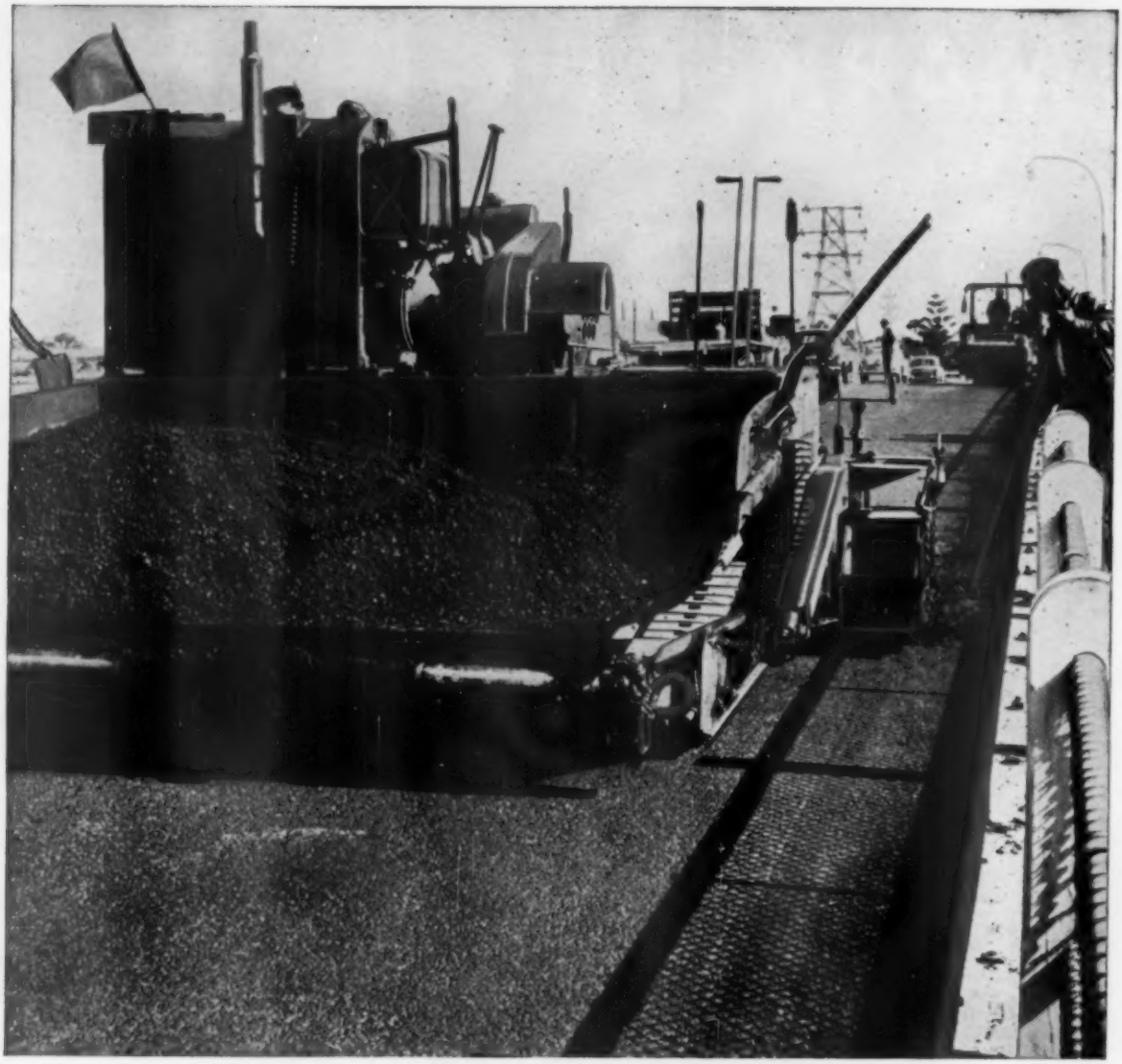

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amount that is satisfactory for the injection pressure, etc.—the higher the pressure, the lower the sand-water ratio.

Water only . . . Some operators in the basin have been fracturing the Mesaverde formation with water only. In doing this the same method is used in choosing the zones to be fractured as where both water and sand are used. The volume, when using water only, will range from 40,000 to 60,000 gal. of water for each zone in the members of the Mesaverde. Injection pressures will range from 1,500 to 2,200 psi., and the injection rates from 45 to 60 bbl. per minute. In some areas the injection pressures will be lower and the injection rates will be higher for the wells fractured with water only, as compared to the wells fractured with water and sand.

About the same time that water only was used in a fracture treatment, the retrievable bridge plug in place of the wire-line bridge plug was introduced. Cable tools were used for the first time in fracturing, because the retrievable bridge plug can be either set or picked up with sand line, wire line, or tubing. Cable tools run tubing and swab the well in after completion of the fracture, because no bridge plug has to be drilled up.

There is no normal break-down pressure of the Mesaverde formation. The Mesaverde is readily susceptible to fracturing, as reflected in the low injection pressures. However, in some cases the perforated zones fail to break down as a result of infiltration of cement into the formation. In this case two methods have been used in order to bring about a break down of these zones. They are: (1) reperforation using a larger charge; or (2) the spotting of acid opposite the perforated zones and holding the acid there under pressure until a break down is accomplished.

Pictured Cliffs

The Pictured Cliffs sandstone is next in importance to the Mesaverde formation. Its average depth will range from 1,800 to 3,500 ft. Cable tools are used for drilling. Use of water in fracturing the Pictured Cliffs did not come about until after the first use of water in the Mesaverde, because of the presence of bentonite in the formation. After water was found to have no detrimental effect on the formation, it was used by most operators in the basin.

The present method of determining the zones to be perforated and fractured is to choose the most probable producing zones from the interpretation of electrical surveys and MicroLogs. Some operators run a gamma ray-neutron before perforating for correlation purposes. The best sand sections determined from the electrical survey and the best porosity determined from the MicroLogs are usually the zones considered to be the most productive. The type of perforations and the equipment for fracture treatment are essentially the same as for the Mesaverde formation.

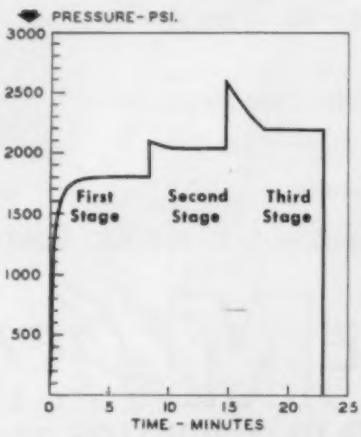
Fracture-treatment size will usually be from 20,000 to 45,000 gal. of water with an average ratio of ½ to 1 lb. of sand per gallon of water. Size 10 to 20-mesh (coarse) and 20 to 40-mesh (medium) sand is being used in fracturing the Pictured Cliffs. Injection pressures will range from 1,200 to 2,000 psi. and the injection rates from 45 to 65 bbl. per minute.

In a few cases the multistage type of treatment is used. Also, in the Pictured Cliffs there is no normal break down. In cases where there seems to be a break down, it is believed to be caused by mud cake or mud infiltration into the formation. Sometimes mud acid is used to break through this mud cake.

Use of Perforation Sealers

Recently rubber balls have come into use in the basin in both the water-sand and the straight-water fracture treatments. Rubber balls are used to plug off perforations that break down at a lower pressure than the other perforations in the same zone. Thus, their use replaces the bridging plugs previously used in selective fracturing of various zones.

The procedure used with rubber balls is to inject them into the fracturing fluid at certain intervals throughout the treatment. The two methods most popular where balls are injected are the slugging method and the single-injection method. In the slugging method enough balls are injected at one time to plug off a certain number of perforations; and in the single-injection method, the balls are injected into the fluid one at a time and the perforations are slowly plugged off.



PRESSURE GRAPH using slugging method with rubber balls. Fig. 1.

In using the slugging method to treat three different zones, the balls are injected twice, dividing the treatment into three different stages. In each stage are enough balls to plug off at least one-third of the perforations. In the single-injection method the injection of the balls is started after approximately 25 per cent of the fracturing fluid is mixed. This enables the perforations that break down first to take a portion of the volume before they are plugged off, and also enables the operator to determine the rate at which the balls will have to be injected throughout the treatment.

Staging with balls . . . An example of the use of the method of slugging the rubber balls can be seen from the pressure graph in Fig. 1. This treatment was in the Pictured Cliffs formation and consisted of 51,000 gal. of water and 45,000 lb. of sand, giving an over-all ratio of 0.875 lb. of sand per gallon of water. In this case the injection rate was 55.8 bbl. per minute and the total number of perforations was 188.

The formation started taking fracturing fluid on the first stage at 1,800 psi. During this stage, 15,000 lb. of sand was mixed with 17,150 gal. of water. Then 75 rubber balls were injected and 15,000 lb. of sand was mixed with 17,150 gal. of water for the second stage. Then 75 rubber balls were again injected and 13,000 lb. of sand and 13,100 gal. of water mixed for the third stage.

After injection of the first set of rubber balls, the pressure increased from 1,800 psi. to 2,100 psi., then dropped to 2,050 psi. when some perforations were plugged and others broken down. After injection of the second set of rubber balls, the pressure increased from 2,050 psi. to 2,600 psi., and then slowly dropped to 2,200 psi. The slow drop in pressure could have been caused by a slow break down of the perforations not plugged by rubber balls. From the pressure chart it may be assumed that three separate zones were actually fractured because of the different injection pressures after the injection of the two sets of rubber balls.

Gradual sealing . . . The single-injection method in conjunction with the use of radioactive sand to determine the effectiveness of rubber balls is illustrated by the log in Fig. 2.

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A gamma-ray log was run before perforating, then again after the well was cleaned out.

In this case, which is in the Point Lookout and Menefee members, the treatment consisted of 59,600 gal. of water and 60,000 lb. of radioactive sand. The method of injection used was to inject 30 rubber balls after mixing 25 per cent of the fracturing fluid, and to continue injecting 10 rubber balls every 50-second period until such time as the perforations taking fluid were plugged off and none of the other perforations would break down. At that time the pressure was released and the rubber balls were allowed to fall away from the perforations they had plugged. Then the remainder of the fracturing fluid was put away.

According to the log, the perforated interval, 4,507 to 4,519 ft., seemed to have taken a portion of the fracturing fluid. The perforations from 4,719 to 4,731 ft. evidently took none. The other set of perforations seemed to have taken part for the fluid through at least a few of the perforations. In the interval 4,666 to 4,675 ft. there is an increase in radiation. The increase could be caused by the radioactive sand being held in vertical fractures caused by the treatment or in fractures already present.

Productivity Increase

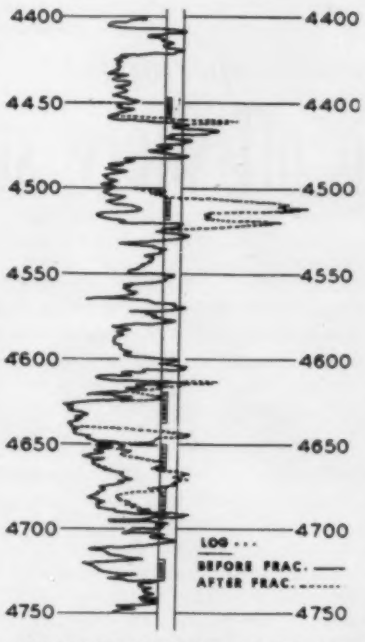
For the Mesaverde wells shot with solidified nitroglycerin, the average pipeline deliverability was about 9 per cent of the initial potential. When the wells were stimulated by sand-oil fracturing in the open hole, the pipeline deliverability increased to about 18 per cent of the initial potential. For the water-sand fractured wells, when the selective perforating, higher injection rates, and large-volume methods were introduced, the average pipeline deliverability increased to about 24 per cent of the initial potential. When using only water to fracture wells, selective perforating, high injection rates, and large volumes were also used, and the average pipeline deliverability was about 17 per cent of the initial potential.

In the case of the Pictured Cliffs wells stimulated with solidified nitroglycerin, the average pipeline deliverability was about 14.2 per cent of the initial potential. The stimulation by sand-oil fracturing the open hole increased this figure to about 14.7. When the wells were stimulated by the water-sand method through the casing, the average deliverability figure increased to 15.5 per cent of the initial potential.

"In the case of the water-only fractured well followed by a water-and-sand fracture . . . the sand acted as a scouring agent resulting in the creation of larger fractures and in this case a larger well potential."

No-sand comparison . . . One operator in the basin has fractured a Mesaverde well with water and sand and then fractured an offset Mesaverde well with water only in order to compare the results of the two different types of treatment. Well A was fractured with 80,000 gal. of water and 92,000 lb. of sand in the Point Lookout member. A total of 94 ft. was perforated with 188 holes and fractured, using the multistage method. The injection rate was 52.6 bbl. per minute, with an average injection pressure of 1,400 psi. Well B was fractured with 120,000 gal. of water in the Point Lookout member. A total of 102 ft. was perforated with 204 holes and fractured with the multistage method. The injection rate was 57.1 bbl. per minute, with an average injection pressure of 950 psi.

Calculated absolute open flow for Well A was 16,387 M.c.f. per day, and the calculated pipeline deliverability at one-half the wellhead shut-in pressure was 1,417 M.c.f. per day. Calculated absolute open flow for Well B was 10,775 M.c.f. per day, and the calculated pipeline deliverability at one-half the wellhead shut-in pressure was 1,499 M.c.f.d. After approximately 10 months of periodic production during the last production period, the average daily production for Well A was 966 M.c.f.d. and for Well B 1,433 M.c.f.d.



GAMMA-RAY LOG before and after fracture with radioactive sand. Fig. 2.

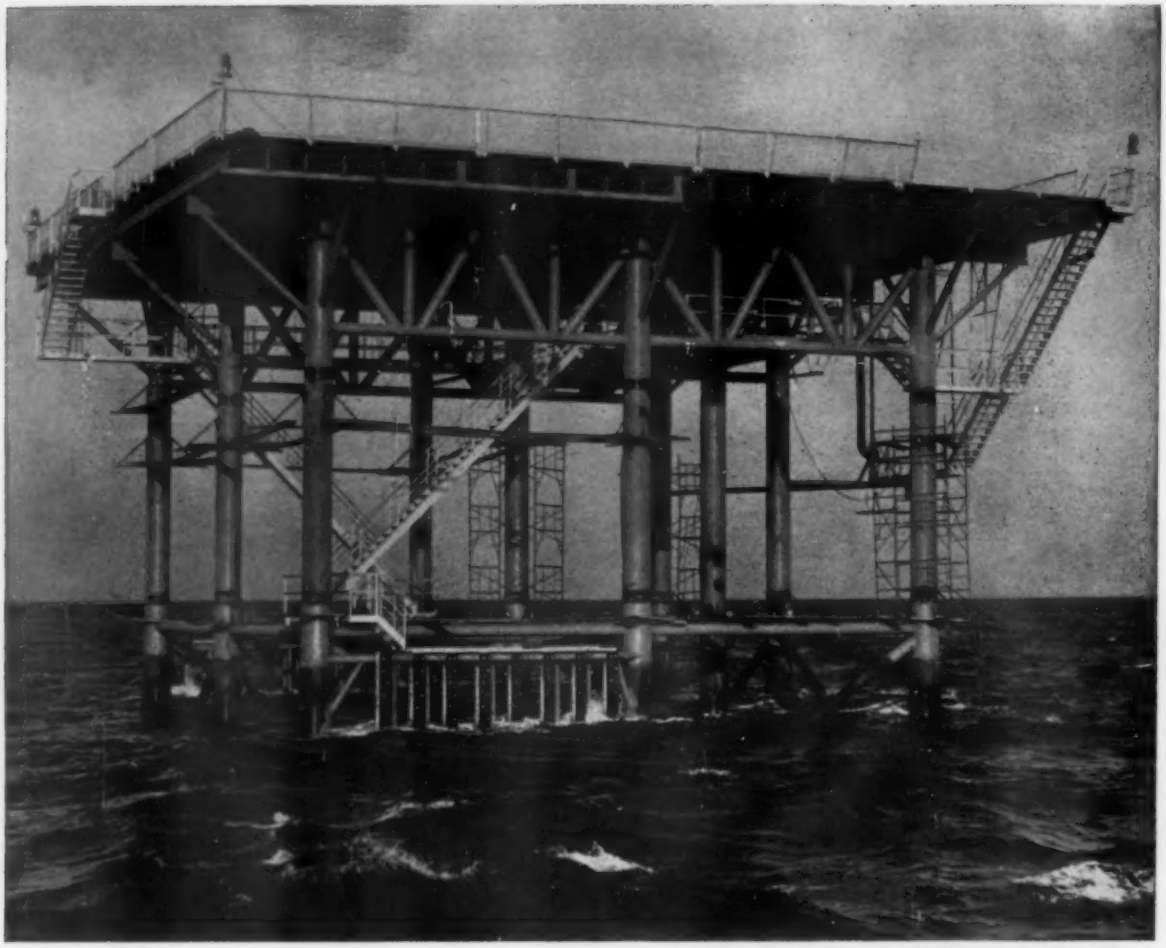
Water, then sand . . . Another operator used the two different types of fracturing in a well in the following way. The Point Lookout member was perforated and fractured in two different stages. The first stage, on the lower zones, was fractured with water only, cleaned out and gaged; then fractured with water and sand, cleaned out, and gaged. The upper zones of the Point Lookout and the lower zones of the Cliff House were fractured in the same manner. The upper zone of the Cliff House was fractured only once with water and sand.

The amount of fluid used in all the zones was approximately 58,000 gal. of water for the water only and approximately 55,000 gal. of water and 55,000 lb. of sand for the water and sand. The results of these two types of fracturing are tabulated folfowing:

	Gage after water fracturing (M.c.f.d.)	Gage after water-sand fracturing (M.c.f.d.)
Point Lookout:		
Lower	1,630	4,160
Upper	1,020	1,210
Cliff House:		
Lower	3,210	2,100
Upper	None	2,500

The calculated absolute open flow for the well was 22,396 M.c.f.d. and the calculated pipeline deliverability at one-half the wellhead shut-in pressure was 3,599 M.c.f.d.

When comparing the results with offset wells, there is an indication that the cost saving of the water-only type of fracturing method is warranted by the deliverabilities compared. In the case of the water-only fractured well followed by a water-and-sand fracture, results indicated, especially in the Point Lookout member, that the sand acted as a scouring agent resulting in the creation of larger fractures and in this case a larger well potential. Several other wells were fractured in the same method as described and similar conflicting results were obtained.



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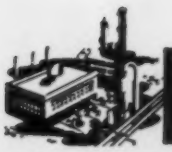
Fluid Flow
Part 1



JOB IMPROVEMENT FOR THE PROCESS FOREMAN—90

How Fluid Flow Affects Refinery Operation

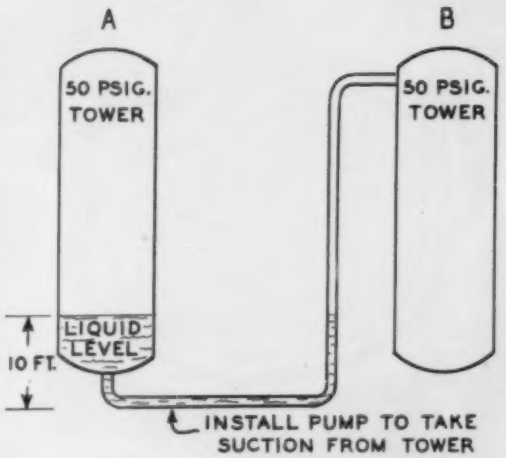
LIQUIDS when confined exert pressure in every direction and if released will flow in the direction of least resistance. Pour a bucket of water on the ground and it will run in whichever direction the ground slopes. This freedom of movement is caused by gravity. A liquid in motion will continue to flow unless the path of flow is blocked or until it has reached its own level.

To move a liquid from one point to another, it is only necessary to provide a downgrade channel and the liquid will flow to desired point. Water is supplied to cities from reservoirs in the mountains without the use of pumps. The downhill grade from the mountains to the city is all that is necessary to move the water. However to move the water from a reservoir in a valley to a town or city near the top of the mountain is another problem and approaches the type of problem that interests us most.

Fluid flow in a refinery . . . The movement of liquids and gases is of great importance in a refinery. Every minute, large quantities of fluids are being moved from one location to another. The flow is from compressors and pumps through pipes, drums, furnaces, fractionating towers, and other styles of refinery equipment.

Downhill grades for moving oil cannot be used in many refinery operations. The reason is that in many instances the flow of oil is from a lower pressure to a higher pressure point. To move a fluid from a low-pressure to a high-pressure area requires external or mechanical pressure. Fig. 1 demonstrates the necessity of applying mechanical pressure for a simple refinery operation.

In Fig. 1, tower A has a bottoms level of 10 ft. Towers A and B operate at the same pressure. The refinery process requires that the bottoms from tower A be transferred to the top of tower B. Remember, a liquid will flow until some other force stops it or until it reaches its own level and in this case there is no force to stop the flow. Therefore the liquid will move from the tower into the line until the level in the line is the same as that in tower A.



MECHANICAL pressure often is necessary to provide adequate fluid flow for a simple refinery operation. Fig. 1.

Mechanical pressure . . . Since the process requires the bottom from tower A to be moved to the top of tower B, it is evident that mechanical or external pressure must be used for transfer. In some cases it might be possible to raise the pressure on tower A, however in most refinery processes, a pump is installed to take suction from tower A and pump it to the top of tower B. This not only moves the liquid but also moves it at the desired rate. The pump can be regulated or the rate may be controlled by use of one of various types of flow-control valves.

Factors Determining Fluid Flow

One of the main factors that determines the physical setup of a refinery operating unit is the rate of flow. When the desired rate of flow for a unit is determined, it becomes necessary to choose the equipment best suited for the job.

Viscosity . . . Viscosity is that property which resists any force that tends to produce flow. This resistance to flow is different for different liquids. For example, place a small block of wood under a pane of glass so the glass slopes fairly sharply. If a little gasoline is dropped on the glass it will run very quickly down the sloping glass. A drop of kerosine will run down the glass also but not quite as fast. A drop of heavy oil will not run but will slide down the glass slowly. A material such as asphalt will hardly slide.

This resistance to movement is called viscosity. Since viscosity causes a fluid to resist flow, it affects the performance of pumps and the pressure drop when pumping through a given line.

Viscosity is important in a refinery because in addition to affecting performance of equipment, many products must meet viscosity specifications to insure proper operation of customer's machines.

Editor's Note: The next installment will contain information about the viscosimeter.

This material taken from process-training-program manual, Baton Rouge, La., refinery of Esso Standard Oil Co.

WHY PIPELINERS DEPEND ON GORMAN-RUPP PUMPS

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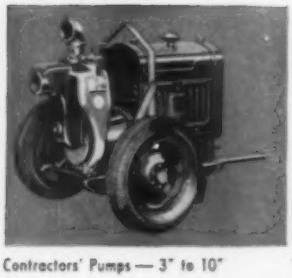

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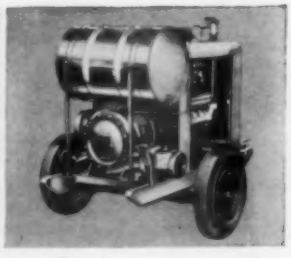

Jetting Pumps

31. How Complexity of Operation Affects Costs of Refineries

By W. L. Nelson
Technical Editor

THE COSTS of complete refineries were indicated in COST-imating No. 27, April 1, 1957, page 204, but more accuracy can be attained by consideration of the amount of lubricating oil produced, and the octane number of the plant gasoline. Whereas refinery costs of $310-$830 per daily barrel were indicated in COST-imating No. 27 for 30,000-bbl. per day refineries, Fig. 1 shows that even greater ranges of cost should be expected. Refineries operating primarily for asphalt are even cheaper (see Curve 7, COST-imating No. 27).

The cost of a specific refinery can be obtained by summing the costs of the individual process units including also such items as storage tanks, chemical treatment, and cost of steam generation. Offsite facilities constitute an additional 38-56 per cent of the total mentioned above, being somewhat as follows:

	Per cent
Fuel-type refineries	40
Complete refineries	43
Lube refineries, 12 per cent	48
Lube refineries, 22 per cent	55
Asphalt refineries	65

Offsite facilities consist of land, fencing, roads, walks, paved areas, dikes, offices, laboratories, locker and shower rooms, cafeterias, warehouses, numerous shop buildings, sanitary and cooling-water systems, steam distribution, waste-water disposal, sewers, surface drains, fire-fighting equipment, yard lighting and general power facilities, communications systems, power plants, etc.

The method can be grasped more easily from COST-imating No. 32 (next installment).

The square points in Fig. 1 were estimated from data published by W. M. Holiday, "Advances in Refining," Petroleum Refiner, September 1950, page 77. It was necessary to correct his data for size (100,000 reduced to 30,000 bbl. per day), for date (from 1950 to 1946), and for amount of TEL used (3 cc. to 2 cc.).

Better correlation than that exhibited in Fig. 1 should not be expected because there are great variations in processing and especially because auxiliary processing operations are not aimed at gasoline octane number or lubricating-oil production. Refineries employing the general processing of 1956 were contemplated although a few low-octane points represent 1946 and 1950 operations.

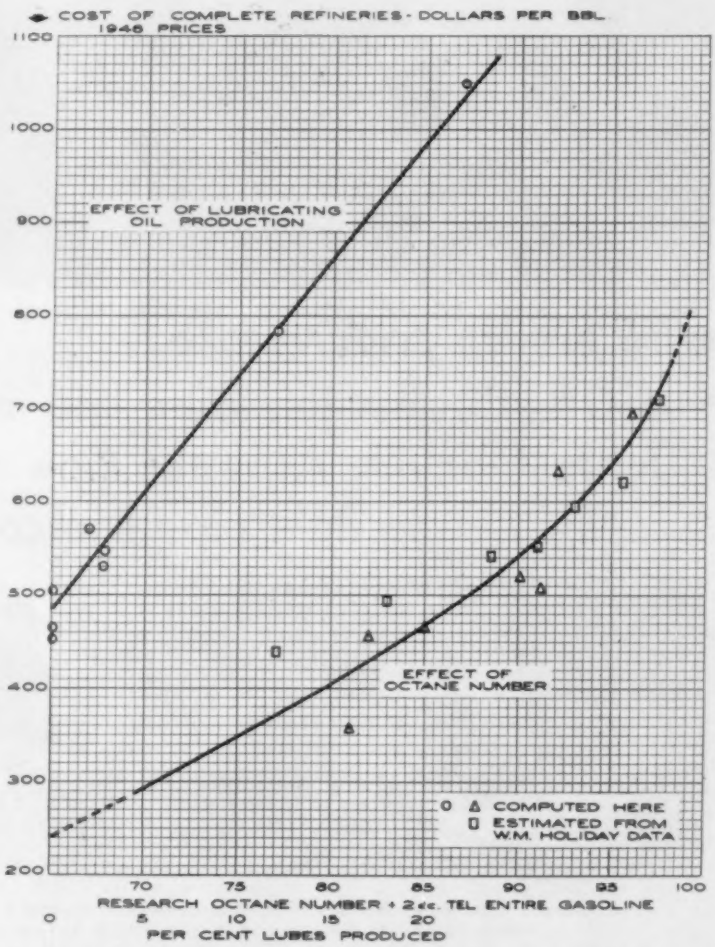

Fig. 1—Effect of octane number and amount of lubricant production on the cost of 30,000-bbl. per day refineries (34.5° A.P.I. crude oil).

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Final Part
Corrosion of
Ferrous-Metal Tubing

REFINER'S NOTEBOOK

Intergranular Cracking and Corrosion

by Thomas M. Krebs

Fig. 19.

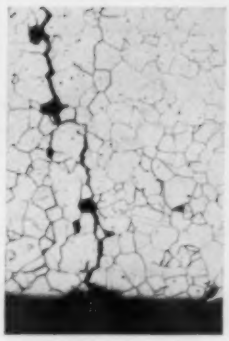


Fig. 20.

Fig. 21.

Fig. 22.

INTERGRANULAR cracking may initiate in conjunction with intergranular attack on austenitic stainless steels. In one instance, intergranular cracking occurred adjacent to welds in Type 304 tubing in catalytic reforming service (Figs. 19 and 20). Apparently, intergranular corrosion and cracking had occurred in the sensitized heat-affected zone of butt welds as a result of attack by acid sulfur-bearing condensate formed in the tubes during shutdown in the presence of high residual stresses from welding.

Also in reforming, considerable chloride and water vapor may be present from the catalyst in the purge period before startup and a situation conducive to transgranular stress corrosion cracking may exist at highly stressed as-welded austenitic stainless joints.

Because of the various possibilities for corrosion, it is suggested that a stabilized grade should be considered for use when austenitic stainless is required in catalytic reformers and that the welds in the stabilized steel be annealed to obtain relief of welding stresses.

Material selection . . . The outlet for corrosive purge gases containing any hydrochloric acid or condensate from the catalyst should bypass the rest of the unit if possible. These conditions point up the fact that under many situations in practical operation, factors other than the design service may require consideration from the standpoint of material selection.

An analogous case to stress corrosion cracking may occur at low or elevated temperatures in the presence of a corrodant and fluctuating stress to produce the attack commonly termed corrosion fatigue. At elevated temperatures the stresses causing difficulty are normally thermal stresses generated by fluctuating service conditions in conjunction with restraint of the member. The section shown in Fig. 21 is from a Croloy 7 vacuum flasher tube which was removed after 7 years service because of excessive oxidation on the fire side.

A brittle failure on hammer test was puzzling since this alloy is not sensitive to temper embrittlement. Examination showed that brittleness was due to transverse notches at the o.d. resulting from accelerated oxidation of metal repeatedly exposed by scale cracks resulting from longitudinal thermal strains. The metal proved to be ductile when the stress-oxidation notches were removed. In more severe cases actual failure may occur in a shorter time. Corrosion-fatigue at elevated temperatures is characterized by transgranular notches containing oxide (Fig. 22).

Author is metallurgist, Tubular Products Division, Babcock & Wilcox Co.
Article presented at Western Petroleum Refiners Association meeting, Wichita.

Summary

We have reviewed some of the various types of corrosion attack to which ferrous materials may be exposed in refinery service. Cases selected provide a basis for examination and consideration of corrosion problems with respect to the three forms of attack described herein. i.e., the general, local, and mechanical-chemical types. Since corrosion difficulties stem essentially from environmental causes, their economical solution depends on proper metallurgical analysis of the problem based on examination and a full knowledge of process conditions including familiarity with local environmental pecularities. Experience, judgment, and imagination are important assets also in this analysis.

Many operators faced with a new corrosion problem in their own units have received helpful assistance by drawing upon the long experience in corrosion matters of Babcock & Wilcox Co.'s Tubular Products Division.

By Robert L. McIntire
The Datics Corp.

EXPLORATION · · DRILLING · · PRODUCTION · · PIPELINE · · REFINING
PETRODatics
ELECTRONIC COMPUTERS

Using Electronic Computers in the Oil Industry

Part 11

Isothermal Flash Calculations

THE isothermal flash calculation is one of the most common of all problems to the refinery technologist or petroleum production engineer. For this reason, the problem serves as an ideal example of the manner in which electronic computers can be used to solve trial-and-error problems.

Although the need for the solution to this problem is almost universal in the petroleum business, the actual equations used are by no means standard. Equation 1 is the expression which the author has found to be the most useful:

$$S = \sum \frac{Z_i (K_i - 1)}{K_i - p (K_i - 1)} = 0 \quad (1)$$

This summation, S, is equal to zero when the correct fraction liquid, p, is finally selected. Z, of course, is the mole fraction of a component, f_i, in the feed. Each component has a corresponding equilibrium constant, K_i.

It is obvious that all practical values of p must lie between zero and one, or must equal one of these limits. When p equals zero, Equation 1 expresses the dew-point relationship. When p equals unity, Equation 1 states the requirement for a saturated liquid at its bubble point. Thus, early blocks in the machine program eliminate cases of all liquid and all vapor. (Notice that the computer proceeds through the print section of the program in any case.)

Once it has been determined that the products of the flash are partly liquid and partly vapor, the computer must have some iterative routine for converging on the correct value of p. The procedure chosen here is probably the most simple and also the most certain of all such routines. It depends upon the theorem of analytical geometry which states that two points determine the equation of a straight line.

As a consequence, we may choose any two values of p between 0 and 1 and place them in machine memory locations A and B. Further, the contents of a third memory location, C, are set at zero in order to force the iteration. (In computing vocabulary, brackets around a memory address are read as "the contents of.") The iteration proceeds by using [B] as the assumed value of p, calculating S_B, and determining if this value is less than the prescribed tolerance, t. If the tolerance is met, then [B] is the correct value of p and the print routine is used.

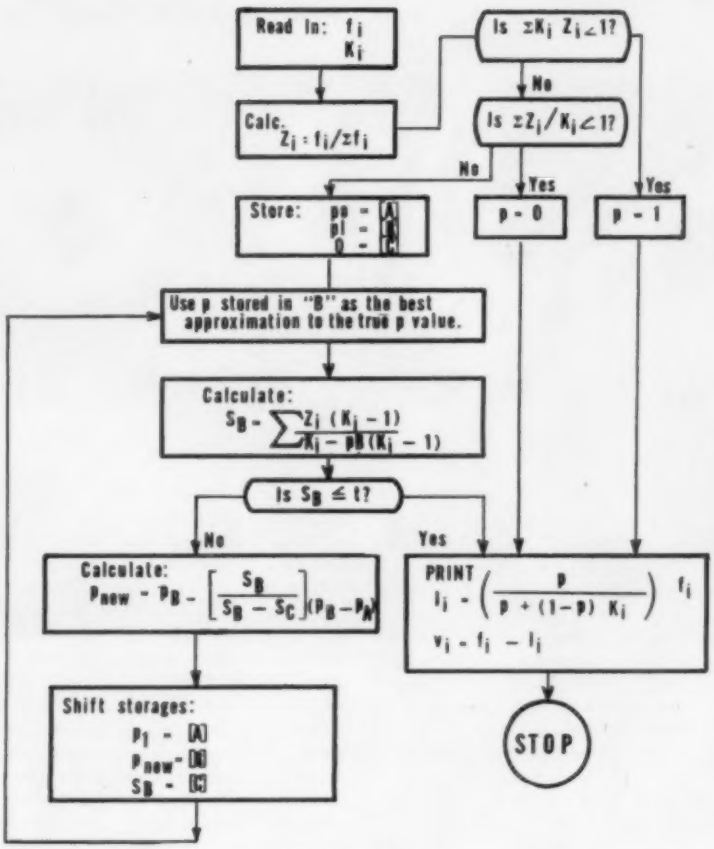
If the tolerance is not met, then the computed results are used to improve the assumption for the value of p. In order to improve this assumption, the intersection of the straight line between two known points with the straight line at S = 0 is derived:

$$\frac{p_2 - p_1}{S_2 - S_1} = \frac{p_1 - p_0}{S_1 - S_0} \quad (2)$$

and

$$S_2 = 0 \quad (3)$$

The resulting equation is shown in the block diagraming of the solution to the problem.


Read In: f_i K_i
Is $\Sigma K_i Z_i < 1$?
No
Calc. $Z_i = f_i / \Sigma f_i$
Is $\Sigma Z_i / K_i < 1$?
No
Yes
Yes
Store: p0 = [A] p1 = [B] 0 = [C]
p - 0
p - 1
Use p stored in "B" as the best approximation to the true p value.
Calculate: $S_B = \sum \frac{Z_i (K_i - 1)}{K_i - pB (K_i - 1)}$
Is $S_B \leq t$?
No
Yes
Calculate: $p_{new} = p_B - \left[\frac{S_B}{S_B - S_C}\right](p_B - p_A)$
PRINT $l_i = \left(\frac{p}{p + (1-p) K_i}\right) f_i$
$v_i = f_i - l_i$
Shift storages: p_1 - [A] p_{new} - [B] S_B - [C]
STOP

Block Diagram

TIDEWATER'S

DELAWARE REFINERY

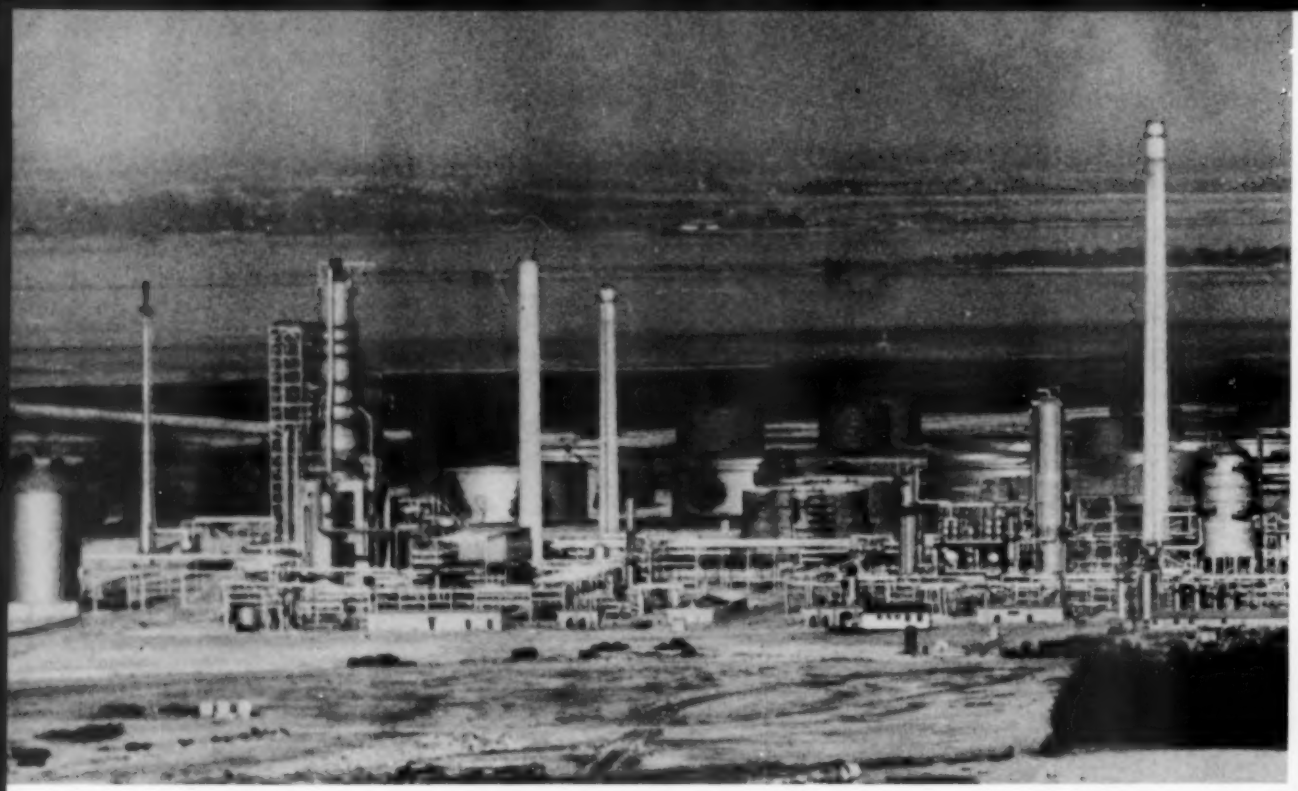
"THE REFINERY OF THE FUTURE"

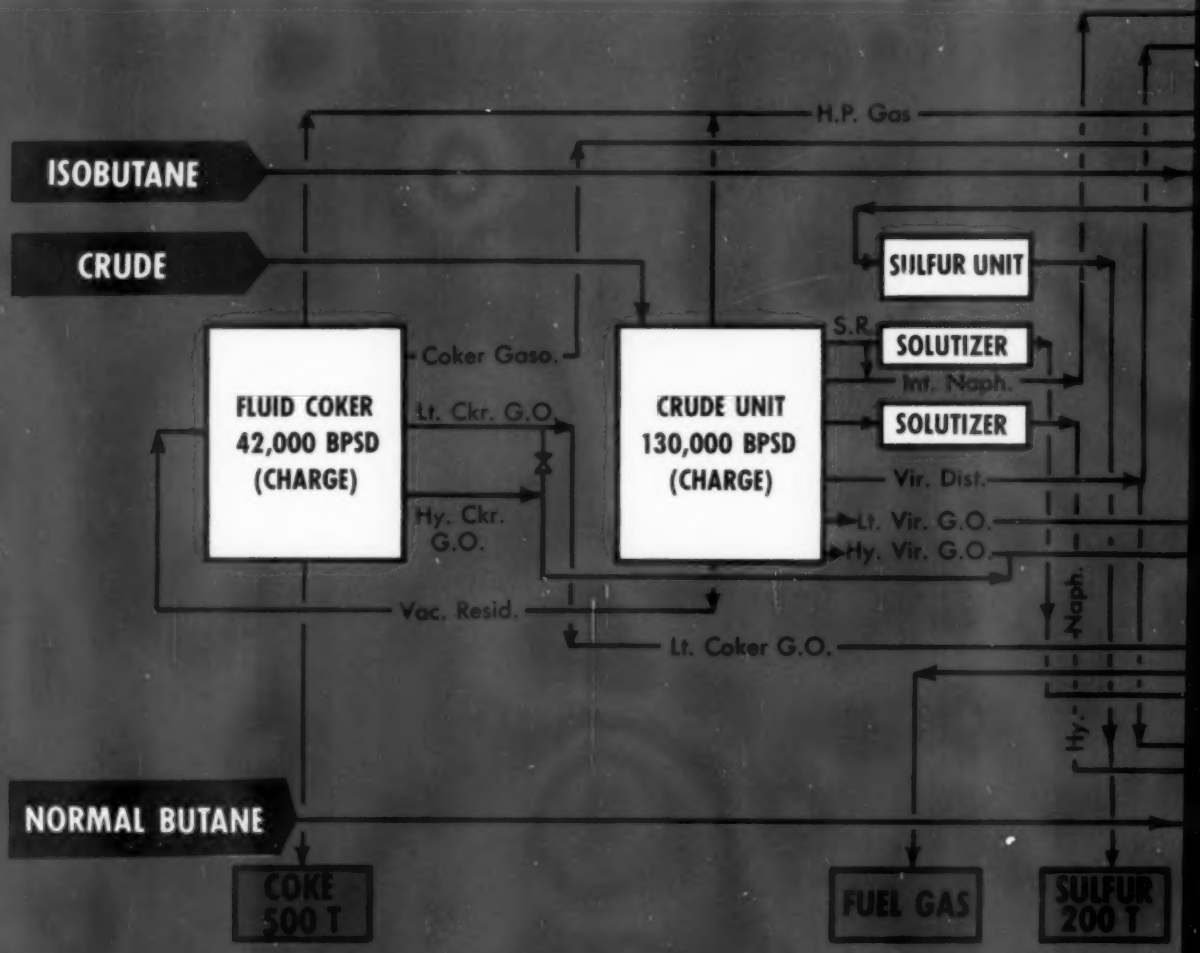
Here's the story of the most modern refinery ever built. IT'S TIDEWATER'S 130,000-bbl. installation near Wilmington

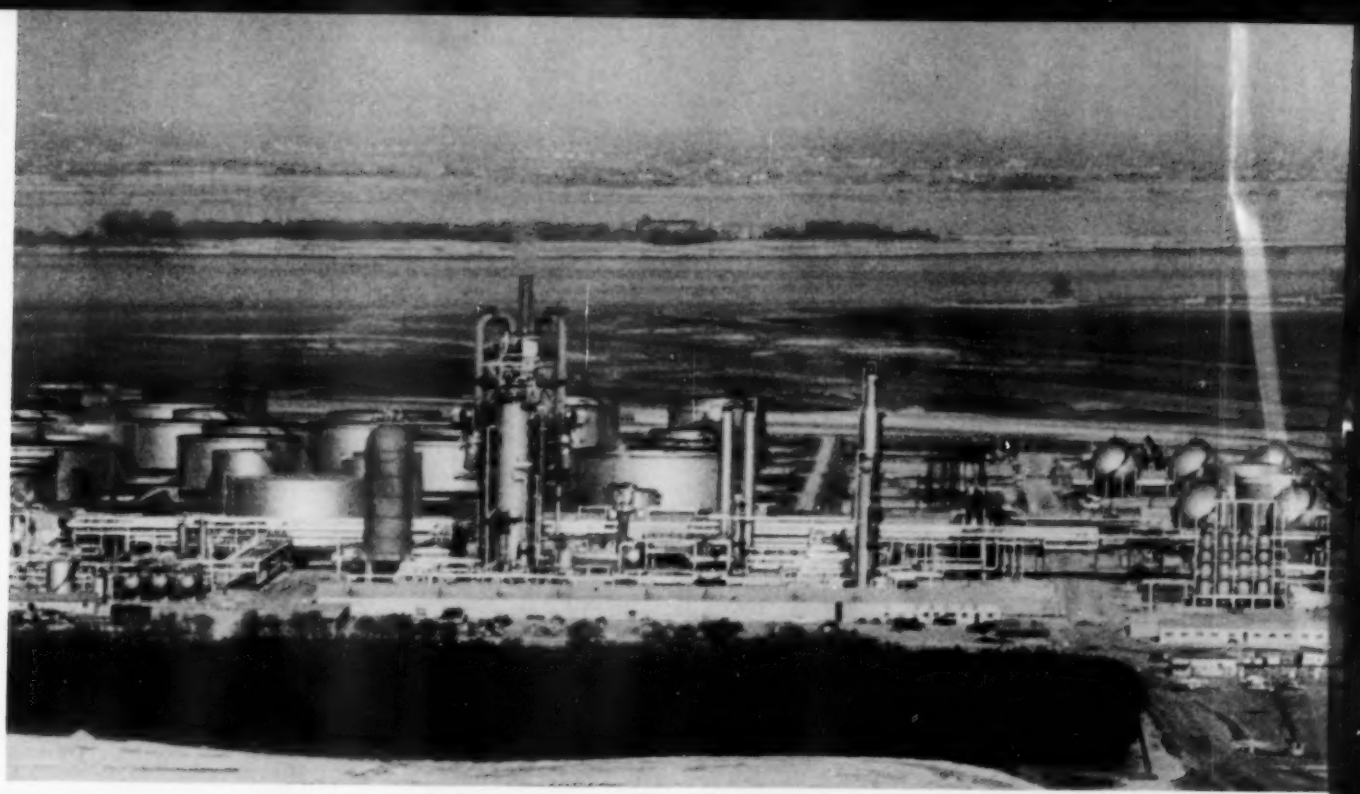
Turn the leaf to see 4-page panoramic photo and flow diagram

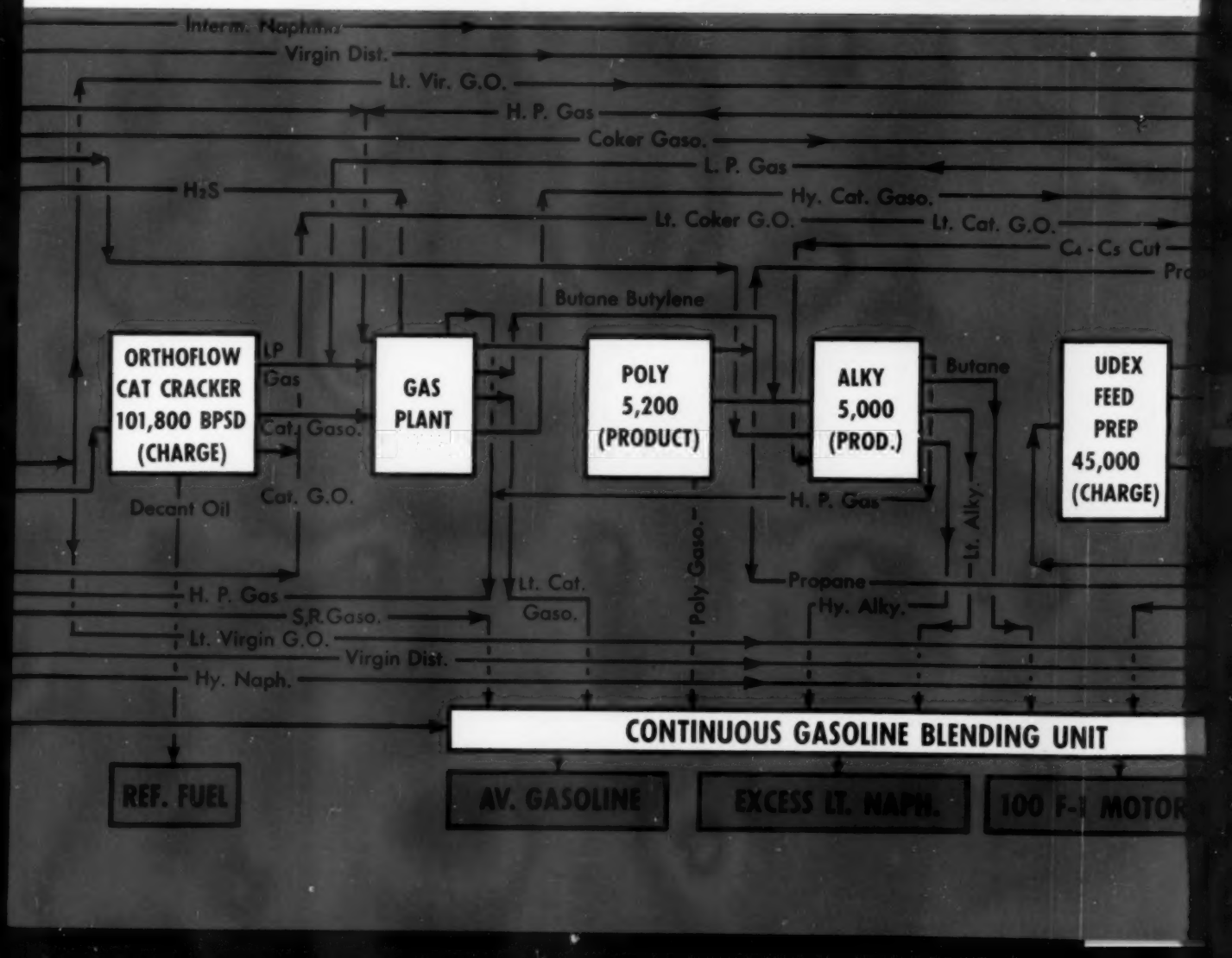
Open to the right to complete
flow diagram and panorama →

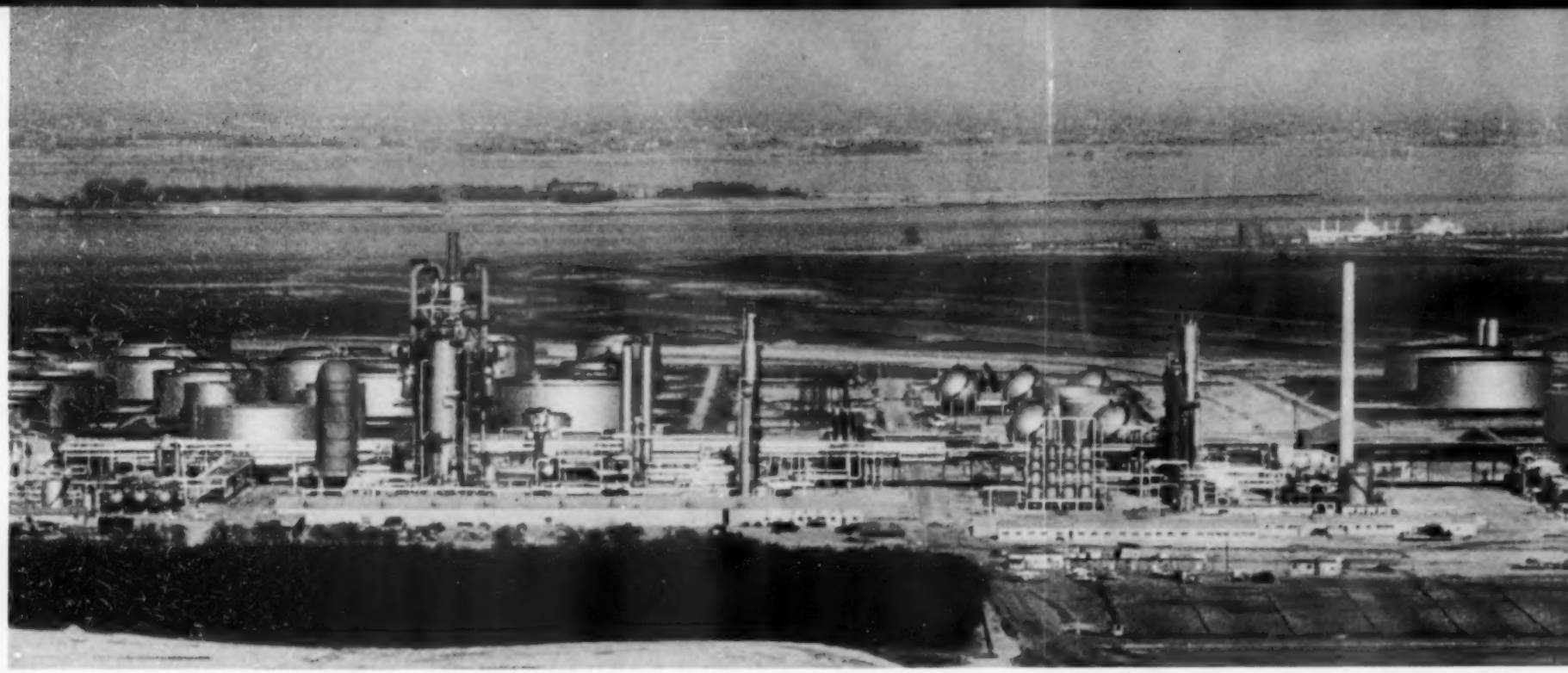
Open to the right to continue
flow diagram and panorama →

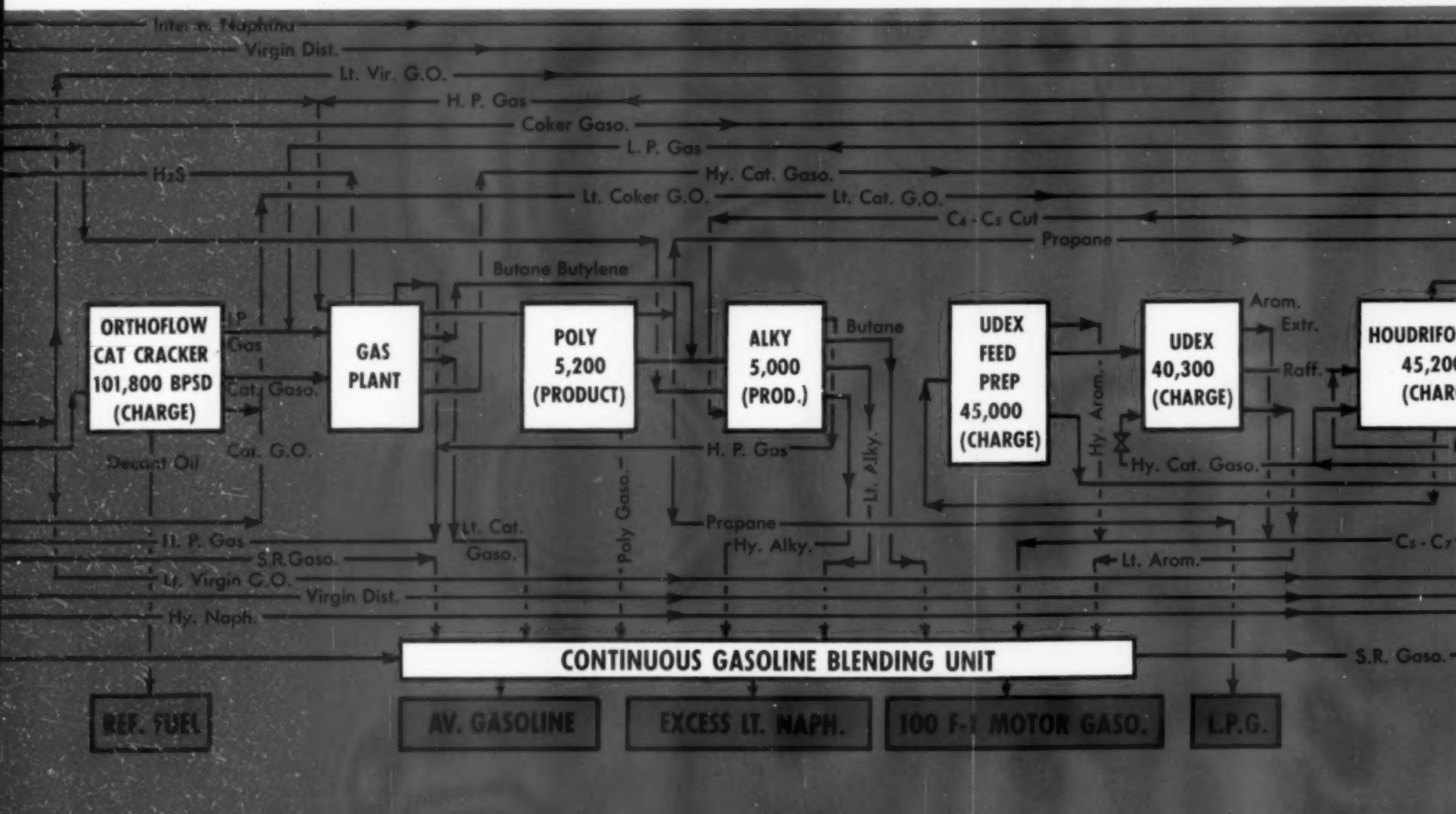



H.P. Gas
ISOBUTANE
CRUDE
SIILFUR UNIT
S.R
SOLUTIZER
Int. Naph.
SOLUTIZER
Vir. Dist.
Lt. Vir. G.O.
Hy. Vir. G.O.
FLUID COKER
42,000 BPSD
(CHARGE)
Coker Gaso.
Lt. Ckr. G.O.
Hy. Ckr.
G.O.
CRUDE UNIT
130,000 BPSD
(CHARGE)
Vac. Resid.
Lt. Coker G.O.
Naph.
Hy.
NORMAL BUTANE
COKE
500 T
FUEL GAS
SULFUR
200 T




Interm. Naphtha
Virgin Dist.
Lt. Vir. G.O.
H. P. Gas
Coker Gaso.
L. P. Gas
H₂S
Hy. Cat. Gaso.
Lt. Coker G.O.
Lt. Cat. G.O.
C₄ - C₅ Cut
Butane Butylene
ORTHOFLOW CAT CRACKER 101,800 BPSD (CHARGE)
LP Gas
Cat. Gaso.
Cat. G.O.
Decant Oil
GAS PLANT
POLY 5,200 (PRODUCT)
ALKY 5,000 (PROD.)
Butane
UDEX FEED PREP 45,000 (CHARGE)
H. P. Gas
Lt. Alky.
Poly Gaso.
Propane
Hy. Alky.
Lt. Cat. Gaso.
H. P. Gas
S.R. Gaso.
Lt. Virgin G.O.
Virgin Dist.
Hy. Naph.
CONTINUOUS GASOLINE BLENDING UNIT
REF. FUEL
AV. GASOLINE
EXCESS LT. NAPH.
100 F-1 MOTOR




Inter. Naphtha
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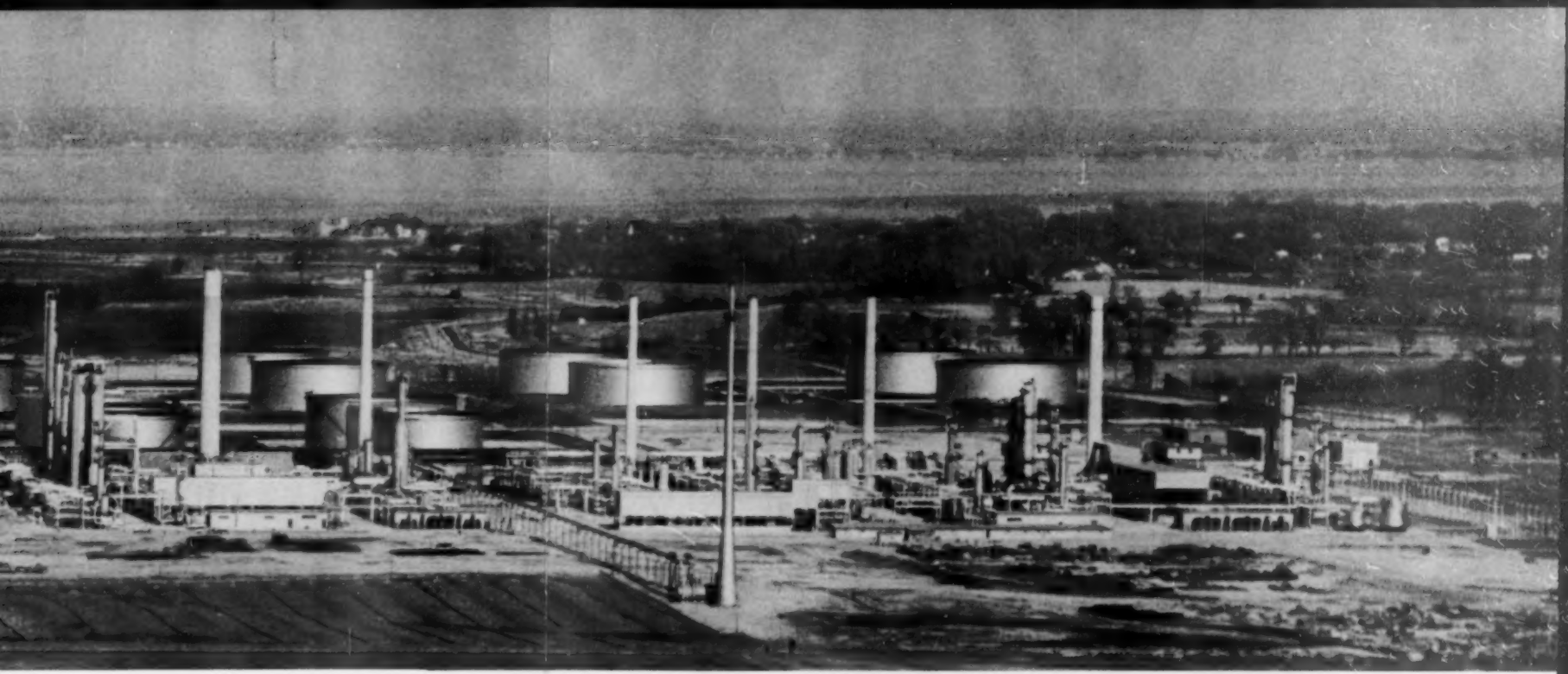
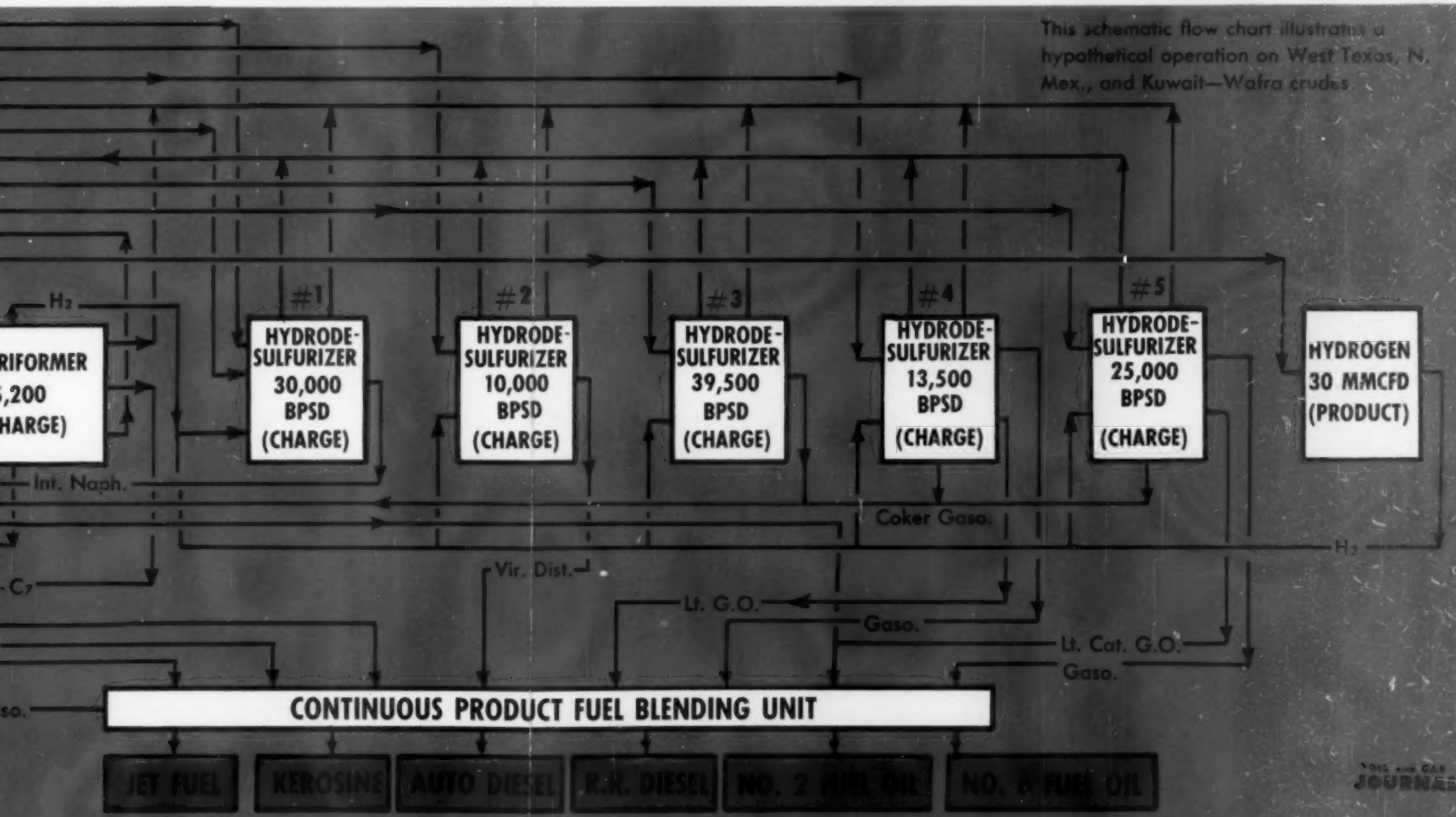
Coker Gaso.
L. P. Gas
H₂S
Hy. Cat. Gaso.
Lt. Coker G.O.
Lt. Cat. G.O.
C₄ - C₅ Cut
Propane
Butane Butylene
ORTHOFLOW CAT CRACKER 101,800 BPSD (CHARGE)
LP Gas
Cat. Gaso.
Decant Oil
Cat. G.O.
GAS PLANT
POLY 5,200 (PRODUCT)
ALKY 5,000 (PROD.)
Butane
H. P. Gas
Lt. Alky.
Poly Gaso.
Lt. Cat. Gaso.
Hy. Alky.
UDEX FEED PREP 45,000 (CHARGE)
Hy. Arom.
UDEX 40,300 (CHARGE)
Arom. Extr.
Raff.
Hy. Cat. Gaso.
HOUDRIFO 45,20 (CHAR
Lt. Arom.
H. P. Gas
S.R. Gaso.
Lt. Virgin G.O.
Virgin Dist.
Hy. Naph.
CONTINUOUS GASOLINE BLENDING UNIT
S.R. Gaso.
REF. FUEL
AV. GASOLINE
EXCESS LT. NAPH.
100 F-1 MOTOR GASO.
L.P.G.

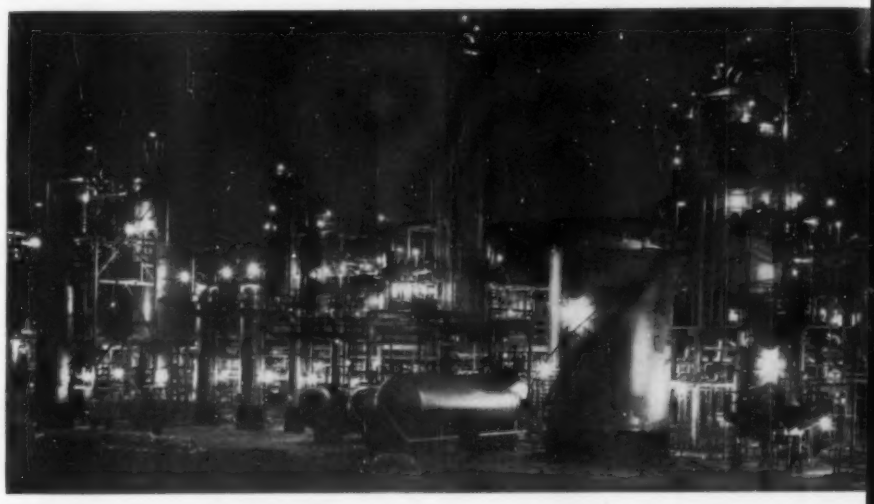


This schematic flow chart illustrates a hypothetical operation on West Texas, N. Mex., and Kuwait—Wafra crudes.



OIL AND GAS JOURNAL

Here's a story studded with superlatives. It abounds with "biggest," "first," "huge." Because . . .



This Refinery Didn't Grow

. . . It started from scratch and emerged full grown—the largest ever built in a single, integrated step

BY J. P. O'DONNELL
District Editor

TIDEWATER'S new Delaware refinery 15 miles south of Wilmington, near Delaware City, is the largest refinery ever built in a single step. That's a distinction but it's not the only one:

1. Six of its eleven process units are the largest ever built.
2. It has unsurpassed flexibility, both in rates of flow and feed quality.
3. It is designed to make products of superlative quality.
4. It has the most complete operating and control information system ever installed in a refinery.
5. All maintenance work is done by outside contractors.
6. Power and steam are furnished by a plant built by others especially for and adjacent to the refinery. Both the power plant and the refinery's crude unit were the first ever designed to burn fluid coke.
7. Products are blended in a continuous, automatic, in-line blending system.
8. Its once-through cooling-water system handles enough water to meet the demands of a city like Philadelphia or Detroit.
9. The marine terminal has an automatic hose-handling unit that enables a single man to connect and disconnect the lines.

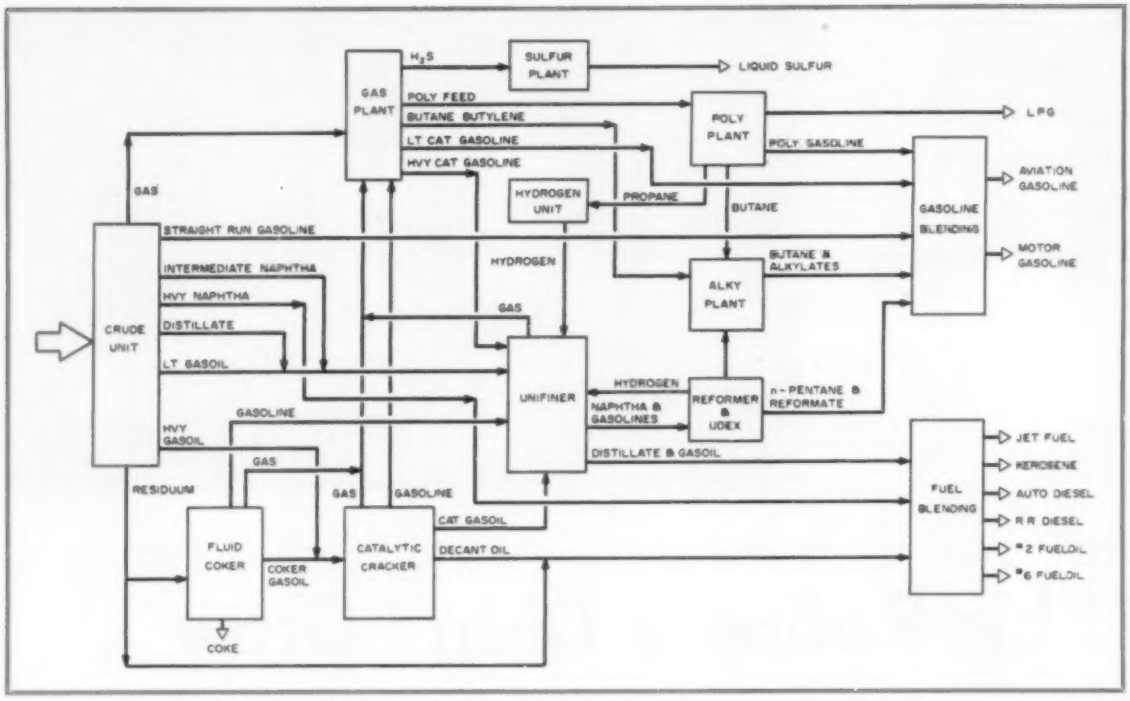
This remarkable refinery replaces the outmoded, confined plant that Tidewater operated at Bayonne, N. J., for more than half a century. The new plant is the world's most modern and it has vast room for expansion on its 5,000 acres.

Well located . . . The location, on the Delaware River, is on the outskirts of the world's No. 1 market for oil products. This is the Philadelphia-New York metropolitan area. The Delaware River provides a deep-water terminal for bringing in crude or shipping out products. The site is believed to be the largest tract ever assembled for industrial purposes on the eastern seaboard.

Actual construction work began in March 1955, when leveling of the site began. It involved the moving of 3,000,000 cu. yd. of earth. That job was dwarfed by the dredging of the 3-mile-long, 400-ft.-wide and 40-ft.-deep channel from the main channel of the Delaware. Some 14,000,000 cu. yd. of silt was removed and used to raise 800 acres of marshland to 12 ft. above sea level. The main refinery site is 60 ft. above sea level.

Engineering and design were done by engineers of Tidewater Oil Co. and C. F. Braun & Co. working to-

SPECIAL SECTION



PROCESS FLOW PATTERN for Tidewater's Delaware City refinery.

gether. Braun handled construction of the refinery. Among the principal units and general facilities in the refinery are nine licensed processes, four of them designed by the licensors. At the peak of activity, 9,000 workers were employed. Braun's job was to erect or install 10,000 carloads and 70,000 truckloads of equipment.

The refinery was not only designed for technological excellence but also to make sure that Tidewater would be a good neighbor. The design was largely influenced by the requirements of the Los Angeles Air Pollution Control District, most exacting in the country.

Tall stacks disperse flue gas. Spent chemicals are neutralized, gaseous products are burned as fuel. Liquid effluents are treated in an extensive system so that the water returning to the river is essentially the same as when it was withdrawn. Sulfur is recovered as a product.

The 11 major units are supplemented by many others; the utilities, marine terminal, administration buildings, laboratory, tankage, etc. The major units stretch out in a single row, 4,500 ft. from one end to the other.

These units are:

1. **Fluid coker.** It will charge 42,000 bbl. per day of vacuum-tower bottoms and produce 1,500 tons of coke and feed stock for further processing. It is the biggest fluid coker ever built and is four times the largest designed up to that point. Its tremendous size is indicated by its over-all height, 250 ft., and the diameter of its burner, 45 ft. Heat release in the burner is over 400 million B.t.u. per hour.

2. **Crude unit.** It will handle 130,000 bbl. per stream day including sour crude of any sulfur content or stocks containing naphthenic acid. Three crudes at a time can be line blended. Crude is processed in three stages, including a prefractionator. The atmospheric column is 23 ft. in diameter and the vacuum column, the largest in the industry, 40 ft. The crude unit has the first heaters to be designed to burn fluid coke.

3. **Fluid catalytic cracker.** The M. W. Kellogg Orthoflow fluid catalytic cracking unit is designed to charge 58,000 bbl. per stream day of gas oil from the crude-unit vacuum tower and from the fluid-coker fractionator. With its recycle rate of 75 per cent, the unit has a capacity of 102,000 bbl. per stream day, making it the largest fluid catalytic cracker ever erected. Coke-burning capacity is rated at 58,000 lb. per hour.

This unit also towers 250 ft. in the air. Its 59-ft.-diameter regenerator is mounted over the reactor.

4. **Gas plant.** Five process units feed the Braun-designed gas plant at rates up to 88,000,000 cu. ft. per day. It is located next to the catalytic cracking unit from which it obtains its principal supply of gas. More important reason for its location is the fact that two gas-oil streams from the cracker's fractionator supply 220 million B.t.u. per hour of reboil heat for gas-plant distillation columns. It is the largest single unit of its kind in the country. Its 356-ton absorber-deethanizer is reported to be the heaviest column lift ever made.

5. **Alkylation unit.** The M. W. Kellogg sulfuric acid alkylation plant will normally produce about 5,000 bbl. per stream day of aviation alkylate. Its charge is 7,500 bbl. per stream day of caustic-treated isobutane-butylene stream from the gas plant and 2,900 bbl. per stream day of extraneous butanes and pentanes from the catalytic reformer.

Production of lower quality alkylate can be increased to 9,000 bbl. per stream day with moderate additions of pumps, exchangers, and lines.

6. **Polymerization unit.** The polymerization and alkylation units share the same plot. The former charges 15,800 bbl. per stream day of light hydrocarbons and produces 5,000 bbl. per stream day of polymer gasoline, 4,000 bbl. per stream day of butane

SPECIAL SECTION

and 5,000 bbl. per stream day of propane. The U.O.P. polymerization unit operates normally on a nonselective basis but can be made selective. Reactors are 8 ft. in diameter and 47 ft. long. They contain five catalyst beds from 2 to 8 ft. in depth.

7. **Catalytic reformer.** While designed to handle 30,000 bbl. per stream day of desulfurized fresh feed and 15,000 bbl. per stream day of paraffinic recycle from the Udex unit, the Houdriformer, licensed by Houdry Process Corp., can accommodate wide variations both in feed quality and feed rate. An idea of its world's largest size is given by the output of the heaters in each of the two trains, 156 million B.t.u. per hour. Each train contains 14 exchanger shells over 40 in. in diameter.

8. **Udex extraction unit.** The U.O.P. Udex extraction unit, largest ever built, operates in three stages: prefractionation section, Udex extraction unit, and rerun column. The first removes heavy aromatics, the second enables the reformer to produce high-octane products with low severity and the third produces aviation reformate and motor gasoline. The prefractionation system can charge 45,000 bbl. per stream day, 35,000 bbl. from the reformer and 10,000 bbl. of heavy catalytic gasoline from Train 3 of the desulfurizer.

9. **Hydrogen plant.** Since the refinery is designed to process high-sulfur crudes, it will have an enormous hydrogen requirement for desulfurization. The net hydrogen production from catalytic reforming will not meet this need. Hence Tidewater has added a plant capable of producing 30 M.M.c.f. of additional hydrogen from propane.

The plant has sufficient flexibility to go as low as 3 M.M.c.f., and will be operated to produce makeup hydrogen over that range. Propane is used as feed stock in the absence of available ethane, or natural gas. But if substitutes for propane become available in the future, the hydrogen plant can be converted to other hydrocarbon feeds with minor modifications.

10. **Hydrodesulfurizer.** The five-train U.O.P. Unifining section is capable of treating 88,000 bbl. per day of various refinery streams—also the largest capacity to date. This record installation of hydrogen-treating facilities enables Tidewater to convert high-sulfur crudes into products with low sulfur content, improved stability, and better color.

This unit also embodies a high degree of flexibility. Each train can treat a different feed and produce separate products, or the trains can combine petroleum fractions with similar properties.

11. **Sulfur-recovery plant.** This plant, licensed by Ralph M. Parsons Co., is the largest sulfur-recovery plant ever built. Since some of the crudes the refinery will process run as high as 5 weight-per cent sulfur, production may go up to 340 long tons per day. The plant can recover that amount but is sufficiently flexible that it can handle less than one-fifth as much. In doing so it recovers high-purity elemental sulfur as a valuable byproduct and, at the same time, removes a source of air pollution. Product from the sulfur plant is stored in the liquid state in above-ground steel tanks from which it can be pumped to insulated tank cars or tank trucks for shipment.

Blending . . . Finished base stocks are blended into finished products in highly flexible, continuous, in-line systems. These systems are largely automatic, which improves reliability and reduces manpower. They are controlled from graphic panels in the control house.

There are three blenders for distillate products. The gasoline blender, served by 11 8-to-16-in. pipelines, can handle seven components at a product rate of 10,000 bbl. per hour. The No. 2 fuel-oil blender can handle five components, also at 10,000 bbl. per hour, and the third, for kerosine, diesel fuel and jet fuel, can handle three components at 4,000 bbl. per hour. Each can also add tetraethyl lead, dye, stabilizer, or other additives.

Instrumentation . . . The refinery has the most complete operating and control information system ever installed either in an oil refinery or any process plant. Information obtained from 4,700 points in the Panellit system is delivered to nine control rooms. Seven of the latter serve the process units, one the utilities, and the other, the tank farm and blending units.

Data from each system appear in four ways: on log sheets, on digital indicators, on trend recorders, and on punched paper tapes. The tapes from all systems will be assembled in a central data-processing facility and, in a matter of minutes, an accurate plant-wide report will summarize refinery operations for the past 24 hours. A complete inventory of all 88 tanks is automatically logged every 8 hours.

Marine terminal . . . Crude comes into the refinery by tanker. And most products also leave by water. The marine terminal, 2 miles from the refinery, can accommodate two supertankers, up to 68,000 tons, and one T-2 tanker simultaneously. It has a turning basin 1,500 ft. wide and ¾ mile long.

Most unusual feature of the marine terminal is the specially designed device for handling hose. It enables one man, by means of a push-button-controlled hoist tower, to connect or disconnect hoses. Twenty-five miles of pipe lines, from 12 to 18-in. product lines to the 30-in. crude line, connect the refinery and terminal. Capacity of the 88 tanks in the tank farm aggregates 7,600,000 bbl. the largest amount of tankage ever erected at one time.

Power plant . . . Both steam and electric power are supplied by the adjacent plant of Delaware Power & Light Co. Maximum requirements are 800,000 lb. per hour of 600-psig. process steam and 40,000 kw. The three boilers are designed to use fluid coke which will be delivered pneumatically from the refinery. The burners will also use refinery gas and residual fuel and can be converted to pulverized coal.

Cooling water . . . The refinery and adjacent power plant use 275,000 g.p.m. of water, equal to the consumption of such metropolitan areas as Philadelphia or Detroit. The moderately saline waters of the lower Delaware River are used for cooling only. Nine 2,000-hp., 600-r.p.m., motors drive vertical centrifugal pumps to deliver the cooling water to the refinery. In physical size, they are among the largest totally enclosed motors ever installed.

Maintenance . . . Tidewater has contracted with Catalytic Construction Co. to do the general maintenance work and Panellit to maintain instruments. Under this system requests for maintenance work originate at the operating units and are turned over to Catalytic and Panellit for execution by an area coordinator.

The system assures Tidewater an adequate staff of competent workmen to meet the fluctuating requirements of maintenance. It also enables Tidewater to measure maintenance costs very accurately. The Delaware refinery will operate with a staff of 500 Tidewater workers.

SPECIAL SECTION

Who's Who in Operation

These are the men who direct manufacturing at the new plant

G. C. CAINE
Manufacturing Department
Divisional Manager

JOHN T. McCOY
New York Office
Coordinator

B. G. JONES

ASSISTANT MANAGERS

JAMES McDONALD

AND THE SUPERINTENDENTS

RAY HARRISON, JR.
Economic Planning and Accounting

M. D. HAYNES

L. E. FORBES
Crude, Coking, and Cracking

E. L. RAUN

R. M. CAMP
Alkylation, Polymerization, Reforming and Desulfurizing

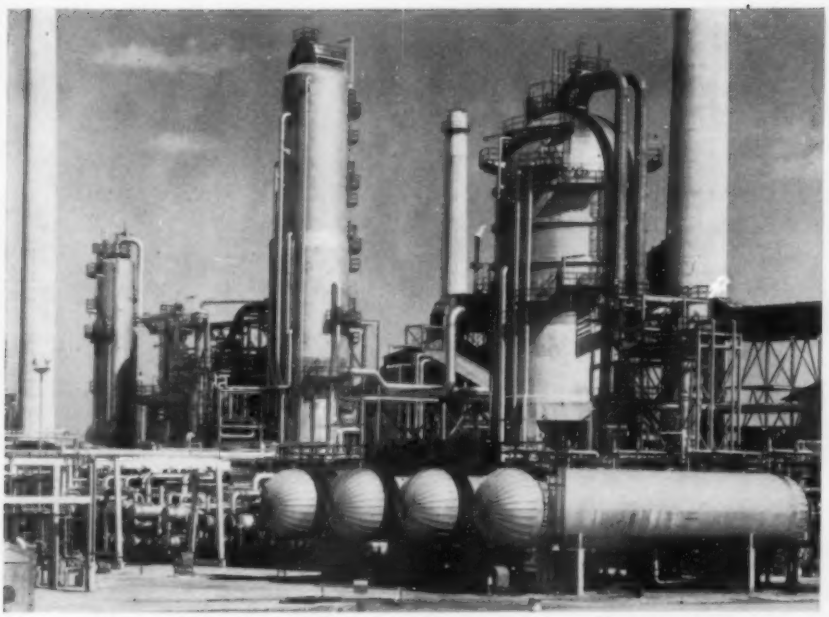
R. B. BEATTIE
Engineering, Maintenance, and Construction

R. M. HUNT
Utilities, Oil Dispatching and Sulfur Recovery

DR. A. W. LEWIS
Refinery Technology

R. S. STANFIELD
Refinery Representative

L. V. SCOTT
Employe Relations Supervisor



WORLD'S LARGEST crude unit, showing gasoline column, atmospheric column, and vacuum column. Desalting drums are in foreground.

Flexibility Is Designed Into the Crude Unit

BY W. E. COLBURN

WITHIN the basic premises of safety, economy, and continuity of operation, the crude unit is designed for broad flexibility. It will handle a variety of crude oils or blends of crudes, including sour stocks of any surfur content or stocks containing naphthenic acids.

This single unit, the world's largest, processes 130,000 bbl. per day, and splits the feed stock into the customary fractions—light ends, light straightrun gasoline, intermediate naphtha, heavy naphtha, virgin distillate, light gas oil, heavy gas oil, and vacuum residuum. Straightrun gasoline and the heavy naphtha are treated on plot, ready for final blending.

The other fractions go on to reprocessing. In addition to the distillation and treating sections, the crude unit plot accommodates the waste-disposal facilities. A single control room serves the group.

Author is chemical senior engineer, C. F. Braun & Co.

Unit control . . . Control of the feed, both rate and blend, centers in the unit's control room. It's possible to line-blend three crudes at a time. Crude oil comes to the plot edge at about 340 psig. and 60° F., is heated to 260° F., desalted, and then raised to about 400° F., all by heat exchange.

The desalting, by electrical precipitation, is accomplished in a two-stage unit. The first stage has a single drum, the second, three drums piped in parallel—all four of the same size. Depending on needs, desalting may be two-stage, one-stage, or bypassed entirely.

Crude reaches the gasoline column at about 400° F., where straightrun gasoline and lighter components go overhead. The condensed product feeds the gasoline stabilizer, the vapor product goes to other units. The bottoms flow through exchangers and a fired heater to the atmospheric column. It's a whopper, 23 ft. in diameter and produces the usual overhead product, three side streams, and reduced crude bottoms.

Two circulating side streams maintain the heat balance. The side products feed to individual stripper sections of a stripper column. The light ends of each cut and the stripping steam return to the atmospheric column.

The top side stream, a heavy naphtha, gets a solutizer treat. The overhead product and the other two side streams are reprocessed further on. The steam-stripped bottoms are pumped through a fired heater and into a vacuum column.

Vacuum operation . . . The vacuum column is the largest in the industry—40 ft. in diameter. It operates at about 750° F. and 17 mm. Hg absolute in the flash zone. Noncondensables and stripping steam pass overhead at about 150° F. Two circulating side streams condense most of the hydrocarbon vapors and maintain the column heat balance.

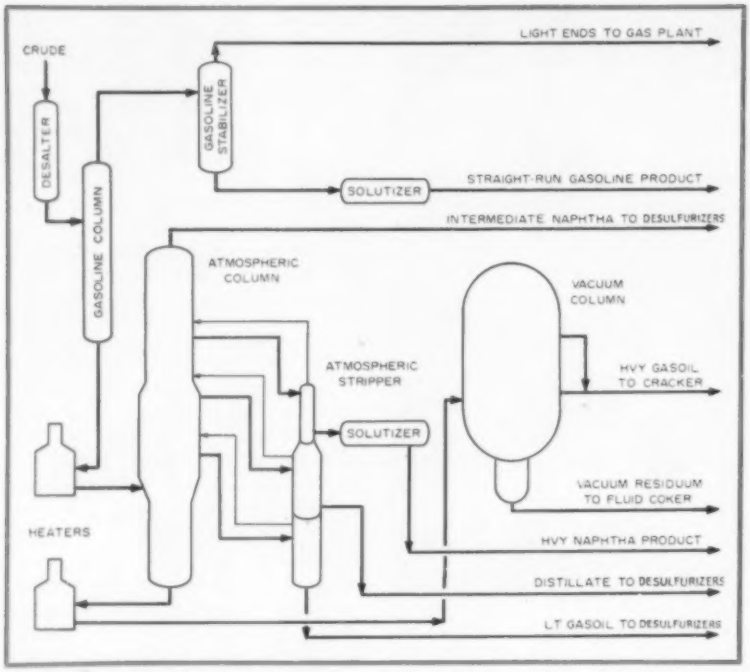
A single product, heavy gas oil, combines the net production of the side stream. The steam-stripped vacuum residuum, cooled to 450° F. by exchange and steam generation, goes direct to hot storage. It feeds to the fluid coker unit. Three-stage steam ejectors and shell-and-tube condensers maintain the vacuum. The condensers have divided water boxes to facilitate tube-side cleaning on the run.

The overhead products from the gasoline stabilizer column feed to the gas plant. The bottoms product, straightrun gasoline, feeds to a solutizer treater, preparatory to final blending.

The solutizer comprises a contacting section for each treated stream, and a regeneration section for the solutizer solution. To save cost and space, rotating disk contactors are used in place of the usual mixer-settler drums.

Waste disposal . . . The waste-disposal facilities handle the entire refinery's foul condensate, and the desalter water effluent. The collected foul condensate is steam-stripped of its acid gas. The stripped vapors pass overhead, through a vapor line that's steam-traced and insulated to prevent condensation and resulting corrosion. The compressor section in the gas plant, and the desalters in the crude

SPECIAL SECTION



SIMPLIFIED FLOW DIAGRAM of the crude unit, which was designed for broad flexibility. It's possible to line-blend three crudes at a time.

unit, reuse most of the stripped condensate.

Separate equipment strips and neutralizes the desalter water effluent. Sulfuric acid neutralizes the caustic, and flue gas from the cat cracker strips out the acid gases. Steam is hooked up as the standby stripping medium. Stripped acid gases from several sources are combined and are burned in the atmospheric fired heater.

Corrosion protection . . . An extensive variety of special materials provides for corrosion protection. Chemical inhibitors are put to use appropriately. Ammonia helps to protect the top section of the gasoline column, the atmospheric column, and each stage of the ejector system of the vacuum column. Kontol affords protection to the overhead duct from the atmospheric column and the ducts of the vacuum column ejector system.

Materials of construction . . . Monel provides protection in the top of the gasoline column, the overhead line, the condenser shells, the water-draw-off pot, and the foul-condensate pumps. Similar protection takes care of the top two-thirds of the gasoline stabilizer column, its overhead line, and condenser shells. Inconel protects the bottom third of the stabilizer, the reboiler lines, and the reboiler shell-side.

Lining and internals of Type 316 ELC stainless steel protect part of the atmospheric column, much of the vacuum column, and the light-gas-oil stripper. Other uses of this same material include the transfer lines between the fired heaters and the columns, and some of the hot pumps. Chrome steels are used for the fired-heater tubes, and the hot process lines.

Design features . . . A number of particular features assure continuity of operation. Bypass lines around the gasoline column, around the gasoline-stabilizer column, and around the vacuum column, permit the unit to operate when one or more of the towers cannot be used. Valving and bypass piping provide a means of shutting down the parallel banks within each exchanger service.

Spare pumps in critical service have automatic pump starters. A pumpout system provides a way of emptying the equipment. Light and heavy pumpout streams are segregated. A seal-oil system keeps instruments operating that are in heavy, viscous services. Normally a product line feeds the seal-oil system, but should the product pump fail, the standby equipment takes over.

The fired heater may be fueled by all fuel gas, or all fuel oil, or mixtures of each. And for the first time in any heater, provisions have been made for the future use of fluid coke.

Pump speed controls the charge rate to each fired heater, thus eliminating process-control valves, in turn saving horsepower.

Relief system . . . A closed blowdown system protects most of the apparatus. The hot relief vapors flow to a quench drum and are cooled to 200° F. before going to the offplot flare. All liquids dropped to the oily-water sewer, flow to the large guard basins and A.P.I. separator. Relief valves on the crude-oil supply header and on the desalter drums protect the apparatus against charge pump shut-off head and fire. These relief valves discharge to the gasoline column unless it is down, whence they discharge to the atmospheric column.

Engineering, design, and construction of the crude unit and its allied facilities were by C. F. Braun & Co.

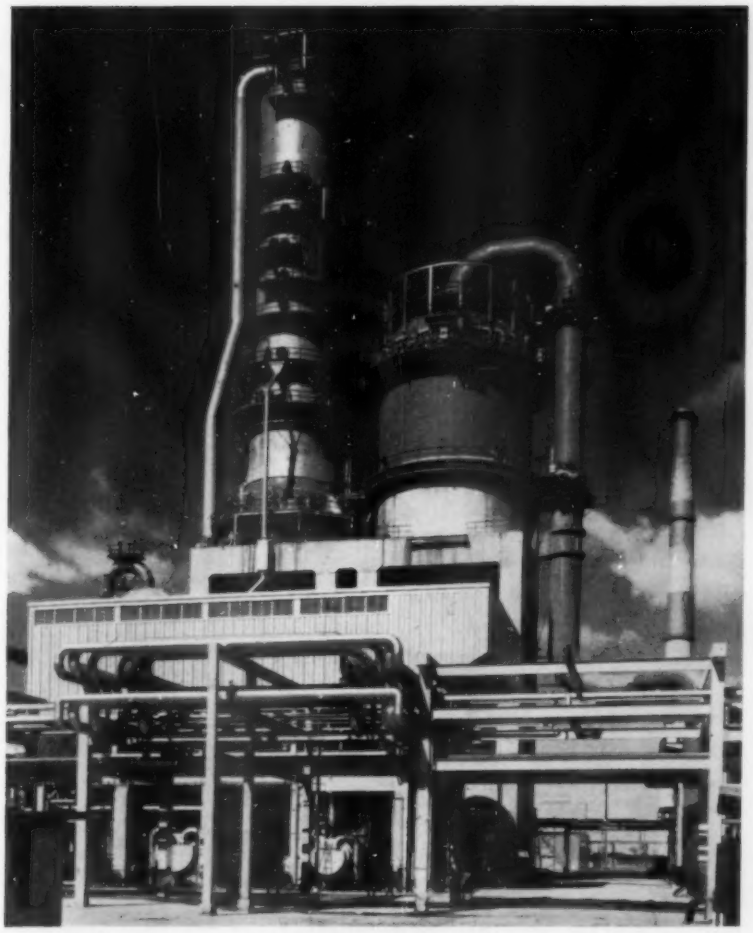
UTILITY REQUIREMENTS

Cooling water, g.p.m.	*23,000
Steam needs, lb./hour:	
40 psig.	108,500
175 psig.	23,500
Power, kw.	1,700
Fuel, lb./hour:	
100 per cent gas	30,000
100 per cent oil	29,500
50 per cent coke	†18,800

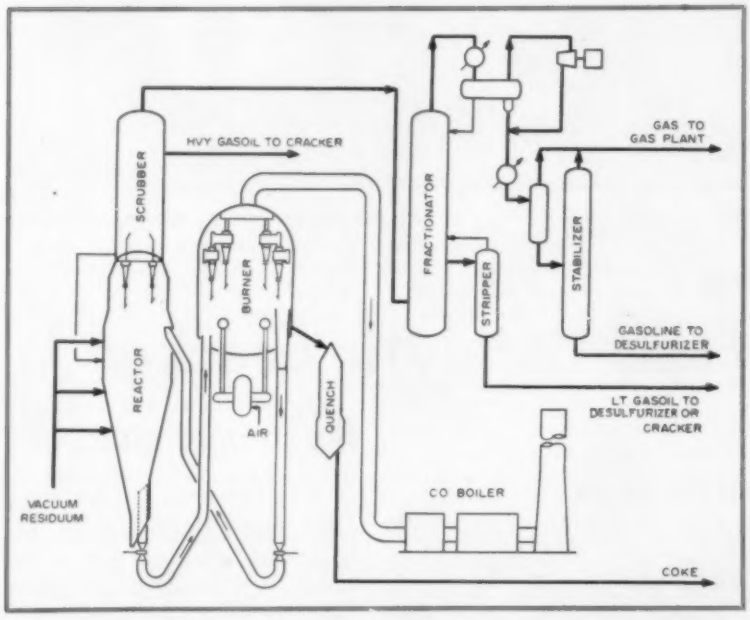
*About half the water is used in more than one service. †This figure is for a future condition when coke-burning facilities are installed. About half the duty will be supplied by gas or oil.

BASIC DESIGN YIELDS

	Per cent of typical charge stocks		
	West Texas	Kuwait	Wafra-West Texas mix
Light ends	0.6	2.9	0.7
Straightrun gasoline	11.7	8.3	8.3
Intermediate naphtha	17.0	15.0	7.5
Heavy naphtha	2.0	4.0	3.0
Virgin distillate	13.0	10.0	7.5
Light gas oil	15.0	10.0	8.5
Heavy gas oil	31.7	32.8	32.0
Vacuum resid	9.0	17.0	32.5
Total	100.0	100.0	100.0



COKER MAIN STRUCTURE with compressor house and pipeway in foreground.



SIMPLIFIED FLOW DIAGRAM of the coker, one of refining's newest tools.

THE Fluid Coker . . . *for minimum production of heavy fuel oil*

BY J. A. WHITCOMBE

ECONOMIC studies led to the conclusion that the refinery should be designed for a minimum production of heavy fuel oil. Further studies pointed up that the fluid-coking process was the most economic method to meet this objective. Installation of the large fluid-coking unit enables the refinery to process the lowest-cost crudes and still obtain a high yield of the more valuable products.

The fluid coker is one of refining's newest tools. It converts heavy, hydrocarbon pitch into lighter gas oils, naphtha, gas, and fine-particle coke. A fluid coker has two outstanding advantages—it's a fully continuous process, and it produces higher yields of liquid products.

The fluid-coking decision was made before any commercial-size coker had gone on stream. The first of these units started up at Billings, Mont., in December 1954. And this Billings coker is less than one-tenth the size of the Tidewater unit.

It was apparent that the combined factors of a new process and a large unit would lead to many design problems. However, the advantages of the fluid process appeared more than enough to warrant the undertaking.

Unit flow . . . Accompanying is a simplified flow diagram of the fluid coker. The reactor contains a deep bed of coke particles maintained at about 950° F. The design feed rate to this reactor is 42,000 bbl. per stream day of vacuum-tower bottoms from the crude unit. This feed is sprayed onto the coke particles in the reactor and remains there until it

Author is process senior engineer, C. F. Braun & Co.

SPECIAL SECTION

TYPICAL FEED AND PRODUCTS

	B/SD	A.P.I.	Tons/day
Feed	42,000	2.5	.....
Products:			
Dry gas, fuel-oil equivalent	3,600	...	.....
C_3's	2,200	...	.....
C_4's	1,400	...	.....
Naphtha, 400° end point	7,300	55.5	.....
Light gas oil, 640° end point	5,000	27.5	.....
Heavy gas oil, 1,015° end point	17,900	12.5	.....
Coke:			
Gross	.....	...	2,060
Net	.....	...	1,600

thermally cracks to form lighter materials and coke.

The lighter materials formed in the reactor flow through cyclone separators and then into the scrubber tower on top of the reactor. Two liquid cuts are removed from the scrubber. The top cut is a heavy gas oil which is sent to the catalytic cracker. The bottom cut is a heavier oil which is recycled to the coker reactor.

The vapor from the top of the scrubber flows to the coker fractionator. Light gas oil is removed as a side cut, and is sent to the catalytic cracker or to the desulfurizer. The light products from the coker are gas and naphtha. The gas is compressed and flows to the gas plant. The naphtha is stabilized and pumped to the desulfurizer. The feed and products from the fluid coker are shown in the table.

Reactor heat . . . The heat energy needed in the reactor is supplied by a stream of circulating coke, which flows to the reactor at about 1,125° F., and then back to the burner at some 950° F. The burner temperature is controlled by burning part of the coke formed in the reactor. Coke product is removed from the burner at 1,125° F. It flows by gravity to a quench tower where it is cooled before going to storage silos.

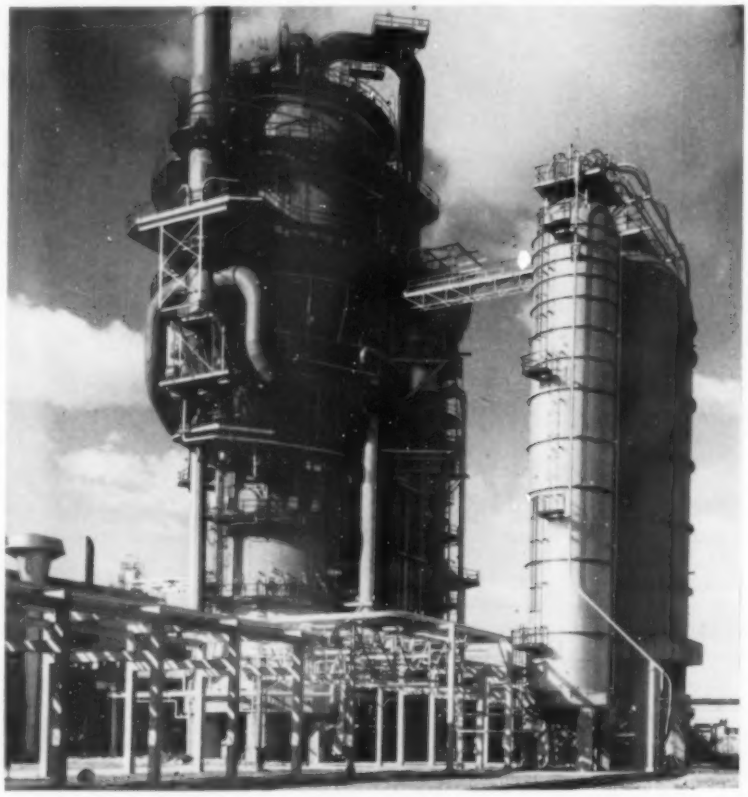
Particle size of the fluid coke is controlled within the unit. It is not necessary to add fresh coke to make up for fine particles contained in the product coke or burner stack gas.

The stack gases from the burner feed a CO boiler. This unit is designed to burn the coke fines in the burner stack gas. The boiler also recovers heat by cooling the stack gas and by burning the carbon monoxide in this gas. Steam generated in the CO boiler, plus steam generated while cooling the reactor effluent, make the coker a large net producer of steam.

The fluid coker in the refinery stands out for size even alongside its huge neighboring units. The scrubbing section on top of the reactor reaches a height of 250 ft. above grade, making the coker the tallest of all the processing units. The diameter of the burner is 45 ft. The heat release in this vessel is over 400 million B.t.u. per hour.

This heat is transferred to the reactor through coke-circulation lines sized for rates of more than 50 tons per minute. The product coke from the unit will be over 1,000 tons per day.

The process is licensed by Esso Research & Engineering Co., who provided the basic process information. Engineering, design, and construction were by C. F. Braun & Co.



ORTHOFLOW F.C.C. UNIT. Converter shell contains reactor, stripping section, and regenerator in a single vessel 250 ft. high.

SPECIAL SECTION

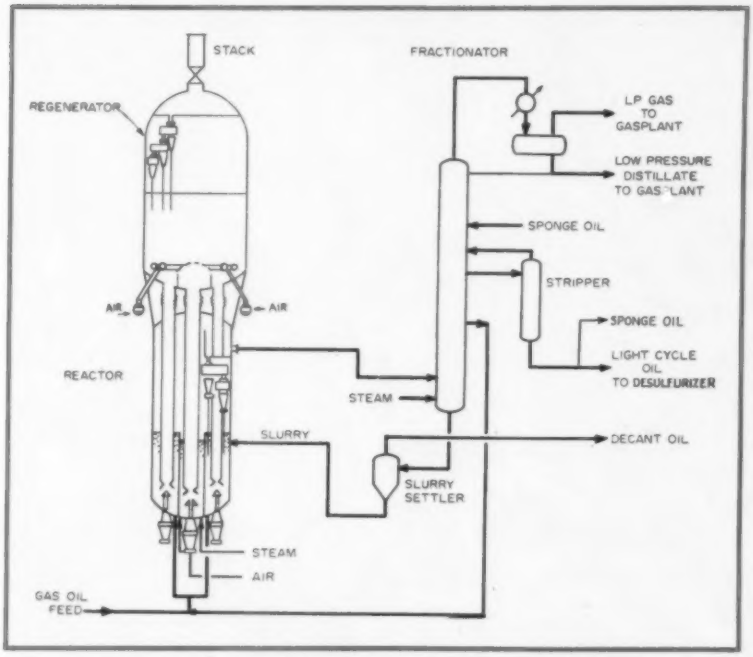
THE Fluid Catalytic Cracker

. . . *the largest ever built*

BY J. M. PHELPS

THE cat cracker is an Orthoflow unit designed to charge 58,000 bbl. per stream day of mixed gas oils derived from heavy, sour crudes. The 75 per cent recycle rate gives a total throughput of 101,800 bbl. per stream day, making the unit the largest fluid catalytic cracker ever built.

Author is senior engineer, C. F. Braun & Co.



SIMPLIFIED FLOW DIAGRAM of fluid catalytic cracking unit.

The gas oil comes to the cracker from two sources. First, from the crude-unit vacuum tower as heavy virgin gas oil. Second, from the fluid-coker fractionator as heavy coker gas oil. The two streams mix in the cracker feed tank.

Except for its great size, the unit follows the conventional Orthoflow process. A single converter shell, 250 ft. high, contains reaction, catalyst stripping, regeneration, and catalyst circulation facilities. The regenerator section is 59 ft. in diameter, mounted atop the reactor section. The catalyst stripping section is in the lower part of the converter, within the reactor but separated from the catalyst bed by a vertical partition.

Stripping . . . The stripper feed slots are located high enough in the stripper for good stripping of entrained hydrocarbons from the catalyst, but low enough to operate with small holdup in the reactor when catalyst activity is high.

Reactor holdup is controlled by varying the stripper level. Air for coke combustion is supplied by a three-stage turbine-driven blower that will deliver up to 161,500 cu. ft. per minute. The blower drive is an 11,250-hp. direct-drive, condensing 12-stage steam turbine that operates at 2,650 r.p.m.

To insure adequate air distribution over the cross-section area of the huge regenerator, a split double-ring distributor was built, with separate air inlets to each half. Regenerator flue gas leaves overhead through three-stage cyclone separators, thereby assuring minimum catalyst losses.

Preheat . . . The reactor fresh feed stock splits into three streams for preheat by exchange with slurry reflux from the fractionator bottoms. The streams recombine and join a stream of heavy cycle oil from the fractionator before entering the reactor. The feed is dispersed by steam as it flows through a special manifold at the bottom of the reactor catalyst bed.

The reactor products, cracked-oil vapors, pass through cyclone separators and flow to the fractionator. In the bottom of the fractionator, slurry reflux circulates over baffles, desuperheating and cooling the entering reactor product stream, and condensing the slurry recycle and decanted oil. Heat removed from the tower by the slurry reflux preheats the cracker fresh feed and generates steam in the slurry coolers.

The slurry settler is a separate cone-bottom vessel in which decanted oil is drawn off the thickened slurry for recycle to the fractionator in order to maintain a low concentration of catalyst in the slurry reflux, usually less than 0.1 lb. per gallon. Thickened slurry returns to the reactor near the top of the catalyst bed.

The fractionator product streams are gas and cracked gasoline, taken overhead and sent to the gas plant. Light gas oil goes to the desulfurizer unit for treating, heavy gas oil is recycled to the reactor. Slurry is decanted and returned to the reactor for catalyst recovery. Decanted oil in excess of that recycled for control, goes to fuel storage.

A portion of the light-gas-oil stream goes to the gas plant for use as sponge oil. Rich sponge oil returns to the cracker fractionator two trays above the drawoff. A portion of the heavy gas oil is used in the gas plant for reboiler service. The cooled oil then returns to the fractionator for reflux through the scrubbing section. These above arrangements are economical because the gas plant is located on the same plot as the cat cracker to minimize the length of piping between the units.

Heat removal . . . The heat-removal facilities in the bottom of the fractionator are designed to give considerable flexibility of operation. To meet the reboiler heat requirements in the gas plant, the heavy-gas-oil reflux duty has been set somewhat above the minimum required by internal fractionator reflux. This is at the expense of slurry duty.

However, to provide adequate heat removal during times when gas-plant reboiler requirements are less than normal, the slurry coolers and the slurry system are designed to operate under minimum heavy-gas-oil reflux conditions with normal hot feed.

Licensing and design were by M. W. Kellogg Co. Procurement and construction were by C. F. Braun & Co. The unit was put on stream 18 months from ground breaking.

Cracker feed stock and products are summarized below:

1. CRACKER FEED

	B.P.S.D.	Per cent
Fresh feed blend	58,000	100.0
Recycle	43,800	75.5
Total	101,800	175.5

2. CRACKER PRODUCTS—DESIGN

	B.P.S.D.	Volume per cent
Dry gas	.....	*2.3
Propanes	.....	9.4
Butanes	7,877	13.6
430° F. e.p. gasoline	29,120	50.3
Light gas oil	18,690	32.2
Decanted oil	1,623	2.8
Coke	.....	*7.5

*Weight.

GAS PLANT serves entire refinery as a central light-ends-recovery and processing unit. Main process columns are debutanizer, gasoline splitter, and absorber-deethanizer.

THE Gas Plant . . . another "largest of its kind"

BY H. A. BAIRD

THE gas plant serves as a light-ends-recovery, cleanup, and treating unit for the entire refinery. It takes liquid and vapor feed streams from six different process units, and produces two vapor and four liquid products. Its capacity is 88 M.M.c.f.d.

The vapor products are sweet gas for the refinery fuel system, and hydrogen sulfide for the sulfur plant. The four liquid products are a propane-propylene cut for poly unit feed, a butane-butylene cut for alkylation unit feed, light cat gasoline for product blending, and heavy cat gasoline to feed Train 3 of the desulfurizer.

Three sections . . . The gas plant consists of three main sections: (1) a conventional absorption and distillation section, (2) a hydrogen sulfide-removal section, and (3) a treating section for caustic washing, doctor sweetening, and inhibitor treating.

Author is project senior engineer, C. F. Braun & Co.

Like several other units at the Delaware refinery, the gas plant is the largest single unit of its kind in the United States. Some of the fractionation columns are the biggest ever used for their services. The 356-ton absorber-deethanizer, for example, was the heaviest column lift ever recorded. To furnish reboil heat for each of two large columns, the debutanizer and the DEA regenerator, there are three parallel kettle reboilers, each of which has some 17,000 sq. ft. of surface.

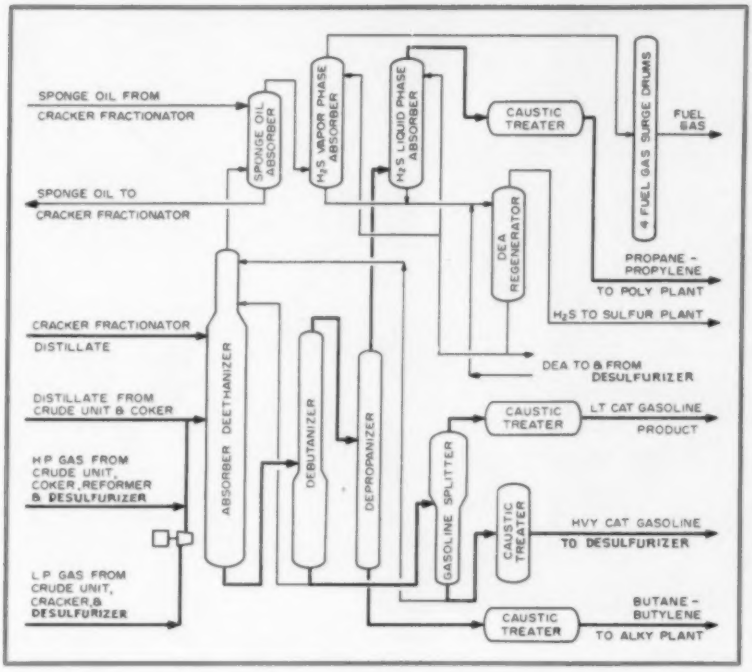
The feed to the absorption and distillation section consists of low-pressure gas, high-pressure gas, and gasoline cuts from the other units. The low-pressure gas is compressed and sent to the absorber-deethanizer along with the other two feed streams. The absorber-deethanizer and sponge-oil absorber are designed for 85 per cent recovery of propane-propylene.

In the H_2S removal section, absorber dry gas, high-pressure sour gas from the desulfurizer, and propane-propylenes from the depropanizer are contacted with diethanolamine solution in vapor liquid phase absorbers where hydrogen-sulfide is removed.

Lean DEA absorbent also goes to a vapor phase absorber in Train 5 of the desulfurizer. Foul DEA returns, is combined with the DEA from the two gas-plant absorbers, and is regenerated in a large single column. A cleanup column and filter operate continuously on a slipstream to keep the DEA solution active.

Treating . . . In the treating section, single-stage and two-stage caustic-wash systems treat poly feed, alky feed, and light cat gasoline. Antioxidant inhibitor, air, and doctor solu-

SPECIAL SECTION



SIMPLIFIED FLOW DIAGRAM of the gas plant, which has capacity of 88 M.M.c.f.d.

tion are added to the light cat gasoline for sweetening. Heavy cat gasoline is caustic washed in a two-stage treater equipped with electric emulsion breakers.

Several plot studies were made before deciding on the location of the gas plant with respect to the other units. Because it is a single facility serving the entire refinery, the gas plant is located near the center of the process area. The gas plant and the cracker are combined on a single plot to effect savings in both initial cost and operating cost.

The most important of these savings is in heat recovery. Two gas-oil streams from the cracker-fractionator provide some 220 million B.t.u. per hour of reboil heat for the gas-plant distillation columns.

Other savings are realized in the piping, structures, and buildings. Since the cracker is the largest gas producer in the refinery, locating it adjacent to the gas plant keeps piping length and sizes to a minimum. Both the cracker and the gas plant are served by a common control house and common switch house.

The common plot offers operating and maintenance advantages for the large centrifugal machines. The cracker-regenerator air blower, the catalyst carrier-line blower, and the two gas-plant compressors are all located on a single elevated operating floor. These machines represent a total of some 28,000 hp. The large suction and discharge piping is brought under the floor, leaving the operating level clear for operation and maintenance. One overhead crane services all four machines.

Equipment selection . . . Careful consideration was given to reliability in the selection of materials and equipment. This is of extreme importance where the operation of several other process units depends on a smoothly running plant.

The two gas compressors normally operated in parallel are multistage centrifugals with direct steam-turbine drivers. Each is rated for 60 per cent of total design capacity and powered for 70 per cent. The extra design horsepower is provided primarily for emergency operation with one compressor down and the other operating at maximum capacity. The turbine drivers, selected for steam balance, use 600-psig. steam exhausting at 40 psig. back pressure.

Particular provisions were made to assure continuous operation of both machines. A lean-oil wash is piped to the suction of each machine to remove gum and varnish from the compressor blades. Condensate connections are provided for periodic desuperheating of the 600-psig. turbine drive steam to wash deposits from the turbine blades during operation.

Again for reliability, all key pumps have spares. Where practical, common spares are used to keep costs down. Hydrogen probes are installed at critical points in columns and accumulators, and wash water is injected at several places to combat hydrogen embrittlement and blistering.

Corrosion inhibitor is injected in the H_2S-removal section to inhibit corrosion from the acid gas. As in other units, piping in corrosive service is safety drilled to indicate when corrosion allowance is used up.

Four 126-in.-diameter by 120-ft. vertical surge drums on the gas-plant plot provide enough pressure storage of fuel gas to run the refinery for 40 minutes should a short-term shutdown of the whole unit be necessary. However, bypass piping and valves allow certain sections to be isolated without shutting down the entire gas plant. All of the facilities were process engineered, designed, and built by C. F. Braun & Co.

THE Polymerization Unit

. . . for high-octane, low-v.p. gasoline

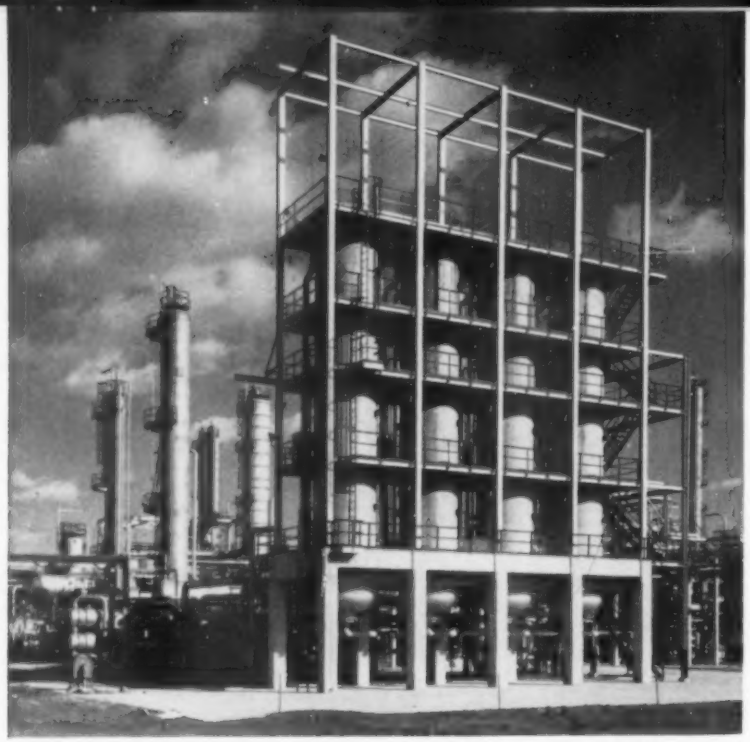
BY S. H. DYER

THE gas plant produces large yields of butenes and propene that have a high octane value. But they also have a high vapor pressure, which makes them undesirable for use as gasoline. The polymerization unit catalytically combines the butenes and propene at elevated temperature and pressure in the presence of a solid phosphoric acid catalyst, producing polymer gasoline having a high octane value and a low vapor pressure.

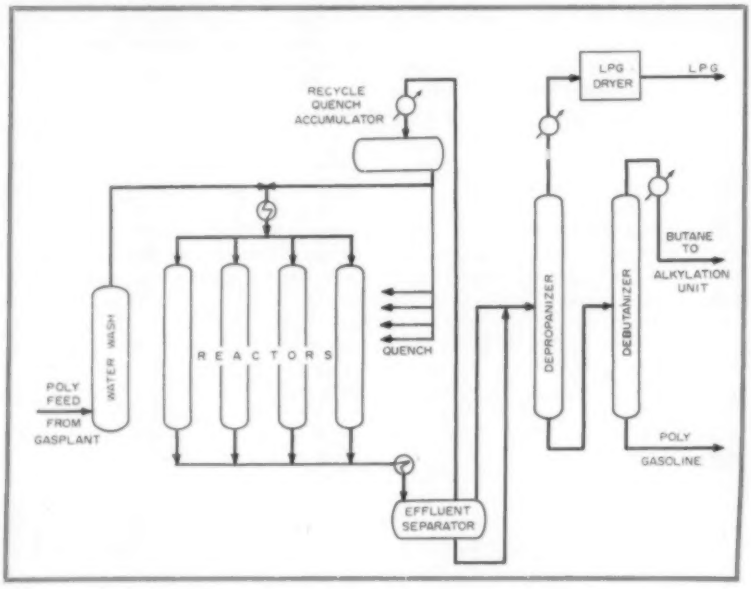
Author is chemical engineer, C. F. Braun & Co.

Process flow . . . Feed to the poly

SPECIAL SECTION



FOUR CHAMBER-TYPE REACTORS operate in parallel handling 15,000 bbl. per day. Feed-prep and fractionation sections are in background.



SIMPLIFIED FLOW DIAGRAM of the catalytic polymerization unit.

plant is water-washed and combined with a paraffinic recycle stream. The recycle stream decreases the concentration of olefins in the fresh feed to prevent an excessively high temperature developing on the catalyst surface, since the reaction is exothermic. The combined charge stream is vaporized and sent to the reactors where polymerization takes place. Reactor temperatures are controlled by injecting a hydrocarbon quench stream between one or more of the catalyst beds.

The effluent stream is cooled and goes to the effluent-separator drum. From here, part of the vapor and all of the liquid goes to a conventional fractionation train where propane, butane, and polymer gasoline are drawn off as products. The vapor remaining in the effluent separator is condensed and used for either recycle or quench.

Feed and products . . . The feed is a mixture of light hydrocarbons containing butene and propene. The feed rate to the unit is 15,800 bbl. per day.

SPECIAL SECTION

The unit is designed to produce approximately 5,200 bbl. per day of polymer gasoline, 4,000 bbl. per day of butane, and 5,000 bbl. per day of propane with the fresh feed stock shown.

Operating conditions . . . The normal basis of operation for this unit is nonselective polymerization, which converts propene-butene mixtures into a polymer that can be blended directly into motor gasoline. This unit is flexible, however, in that it can also operate on a selective polymerization basis. The selective operation processes butenes to give a product which after hydrogenation could be used as a blending stock in aviation gasoline.

The reactors normally operate at temperatures of 350°-450° F. and 500-700 psig. The temperature rise through the reactors is controlled by the proportion of recycle to feed or the amount of reactor quench.

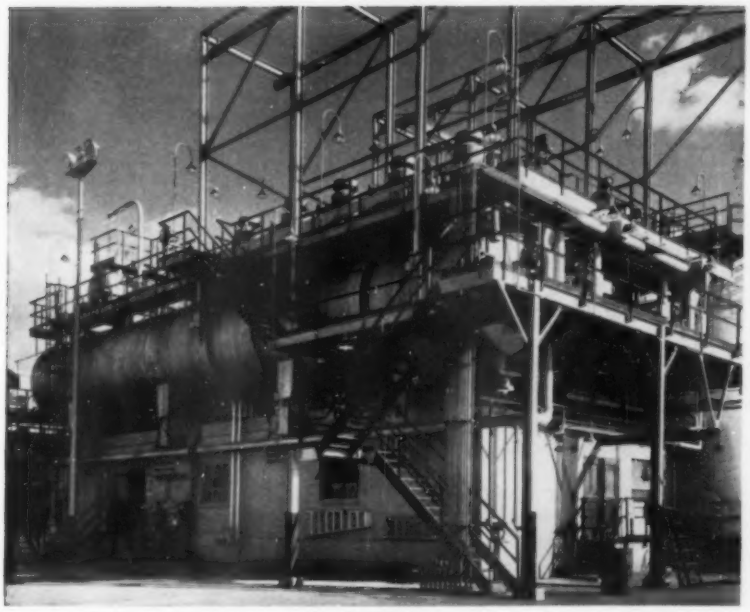
Equipment . . . The chamber-type reactor is used due to the impracticably large number of shell-and-tube reactors required to perform the same job. The catalyst is loaded into the reactors by means of a mobile conveyor-elevator. The pellets are picked up from the feed bin by the conveyor-elevator of the self-closing belt type and delivered to a hopper at the top of the reactors.

Licensor . . . The design and specification for the reactor section of the poly plant was by Universal Oil Products Co. Design and specification of the fractionation train was by C. F. Braun & Co. Engineering, procurement, and construction of both sections were by C. F. Braun & Co.

Feed stock and production . . . Design capacities for feed stock and products are summarized below:

Feed:	B.P.S.D.	Volume per cent
Ethene	17	0.1
Ethane	195	1.2
Propene	4,700	29.6
Propane	4,350	27.5
Isobutane	2,930	18.5
Butene	3,000	18.9
Butane	660	4.2
Total	15,852	100.0

Products:	B.P.S.D.	Volume per cent based on feed
Propane	4,824	30.4
Butane	3,888	24.6
Polymer gasoline	5,136	32.4
Total	13,848	87.4

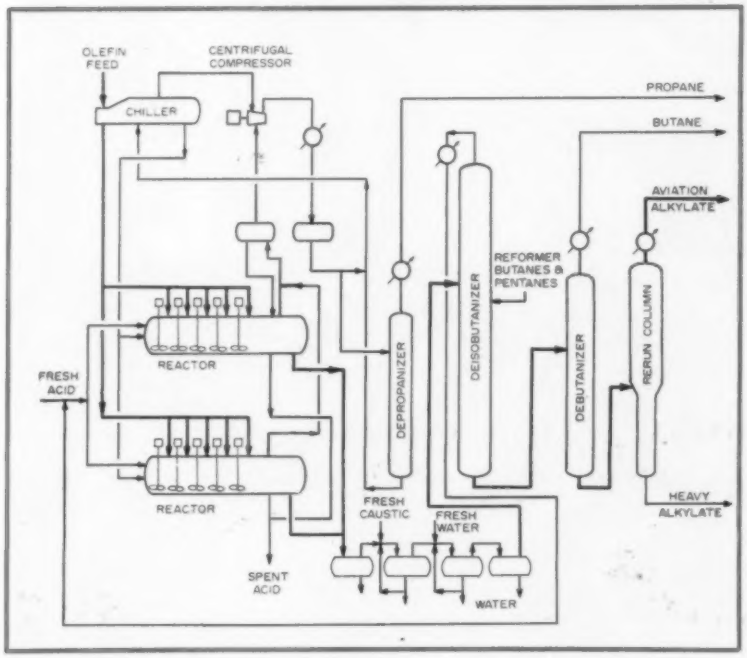


TWO CASCADE-TYPE REACTORS in this structure operate in parallel to produce over 5,000 bbl. per day of aviation-grade alkylate.

THE

Alkylation Unit

. . . for production of aviation fuel



SIMPLIFIED FLOW DIAGRAM of alkylation unit. Feed consists of 7,500 bbl. per day of a butane-butylene stream from the gas plant.

THE alkylation unit combines isobutane with olefins produced in the catalytic cracker and the fluid coker, to produce aviation-grade alkylate in the presence of sulfuric acid catalyst.

Design capacity is 5,000 bbl. per stream day of total alkylate comprising 95 per cent light aviation-grade product. This rating is sized for present operations. By the moderate addition of exchangers, pumps, and lines, the unit can be expanded to produce over 9,000 bbl. per stream day of total alkylate.

Feed to the unit consists of 7,500 bbl. per stream day of a butane-butylene stream from the gas plant. This predominantly olefin feed is caustic-treated to remove mercaptan sulfur for low acid consumption. It is then chilled, partially dried, and charged directly in parallel flow to the five sections of the two unit reactors.

More isobutane . . . An extraneous 2,900-bbl. per stream day stream of butanes and pentanes from the catalytic reformer is charged to the fractionation section of the unit. This stream provides an added source of isobutane to make up for the deficiency of that important reactant in the gas-plant effluent.

This added isobutane is recovered overhead from the deisobutanizer column and is charged together with recycle isobutane, acid, and isobutane-rich refrigerant, in series flow to the two reactors. Thus isobutane concentration is maintained at extremely high levels in the reactor, with a minimum quantity of deisobutanizer overhead recycle.

Each of the two Kellogg Model C cascade reactors contains five reaction zones, an acid-settling zone, a hydrocarbon effluent-surge zone, and a vapor disengaging zone. An autorefrigeration cycle maintains the reaction temperature at 30° to 40° F. to favor formation of best quality alkylate. Regulation of propane inventory in the reactor system controls the temperature.

Alkylate quality is appreciably affected by propane dilution in the cascade reactor. Hence, they are operated at minimum pressure to reduce propane inventory. Propane is rejected from the refrigerant stream, by controlled withdrawal overhead from the depropanizer column where propane concentration is highest. These control measures result in a substantial improvement in alkylate quality.

SPECIAL SECTION

Effluent treating . . . Reactor effluent is heated by exchange, then caustic and water-washed before feeding to the deisobutanizer. Design and operational improvements incorporated in the effluent treating system remove essentially all traces of acid and esters and have resulted in minimum plant fouling. Butane product is removed overhead, and debutanized alkylate charged to a rerun system comprising a preflash drum and a rerun column.

A combination of vacuum operation and open stream injection keeps the bottoms temperature of the rerun column low enough to prevent thermal decomposition of neutral esters present in the heavy alkylate. Ammonia and triethanolamine added to the column overhead vapor lines hold the deleterious effect of ester decomposition to a minimum.

Key exchangers subject to fouling have block valves and bypasses so they may be taken out of service for cleaning while the unit remains in operation.

Steam does double duty in the unit, promoting economy. Power steam for pumps and compressor turbines is condensed in reboilers and preheaters of the fractionation section. Pumps in various services are equipped with alternate electric-motor and steam-turbine drives which can be switched to keep the plant in steam balance, and to maintain minimum utility requirements.

Versatile flow . . . The Tidewater alkylation unit has a versatile flow arrangement, permitting the processing of a wide range of feed stocks. While butylenes are the principal olefin feed, an appreciable quantity of amylenes and propylenes in that order of preference can also be alkylated. Their admission is limited only by availability of isobutane.

With a mixed-olefin feed, it is possible to produce between 5,000 and 6,000 bbl. per stream day of alkylate showing a rich-mixture aviation-gasoline performance number of 157-160 (F_4 + 4.6 cc. TEL). This is accomplished at the exceptionally low sulfuric acid consumption of less than 0.3 lb. per gallon of total alkylate. At 50 per cent of design capacity, alkylate of 167 F_4 PN was produced from a mixed butylene-amylene feed.

The process engineering and design on the unit were by M. W. Kellogg Co. Procurement and construction were by C. F. Braun & Co.

(Information for this process description supplied by S. R. Stiles, process engineering department, M. W. Kellogg Co., and by Hugh A. Baird, project senior engineer, C. F. Braun & Co.).

THE

Extraction Section

. . . high octane, low reforming severity

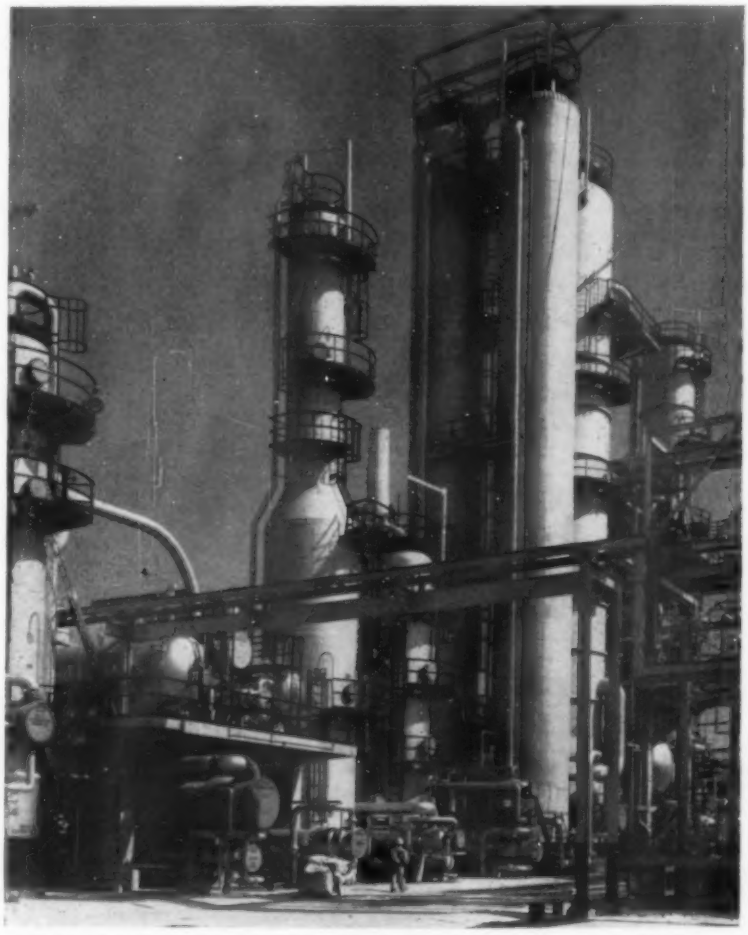
BY H. W. DAY

THE extraction section consists of three parts — a prefractionation section, a Udex extraction unit, and a rerun column to produce aviation reformate. The prefractionation section is designed to handle a feed charge of up to 45,000 bbl. per day—35,000 bbl. per day comes from the reformer unit, and 10,000 bbl. per day of heavy catalytic gasoline comes from the Train 3 desulfurizer. The main purpose of the prefractionation section is to remove the heavy components from the extractor feed.

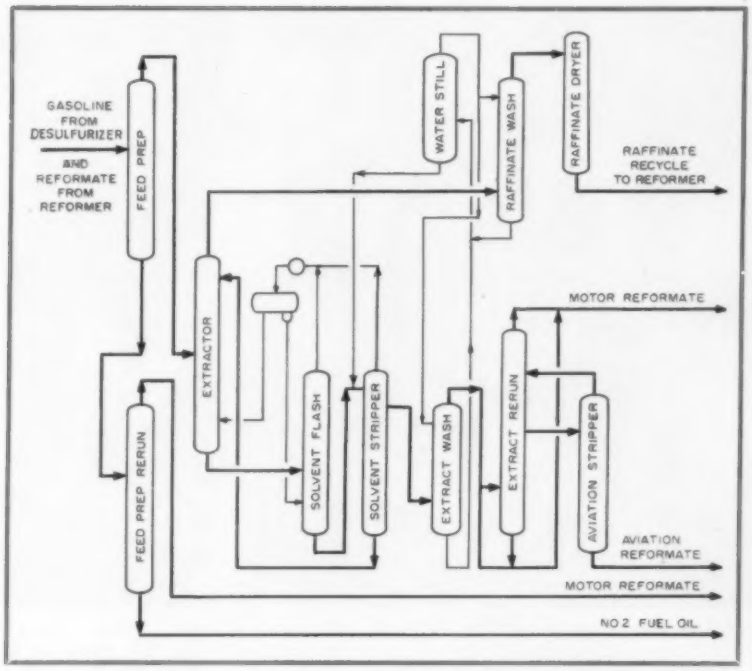
The purpose of the extraction section is to allow the production of high-octane products with low-severity operation of the reformer. This is done by removing aromatics from the reformer product stream. The glycol solvent removes these aromatics. The paraffinic raffinate from the extrac-

Author is chemical senior engineer, C. F. Braun & Co.

SPECIAL SECTION



THE UDEX UNIT is the heart of the extraction section. Tall columns in the background are the two extractors and the solvent-flash and stripper tower.



SIMPLIFIED FLOW PATTERN for the Tidewater extraction unit.

tion stage, first water-washed free of solvent, is dried by distillation and then recycled as a feed stream to the reformer.

The extract is freed of solvent by a preliminary flash and a subsequent stripping operation. The extract overhead from the stripper is washed free of solvent. The solvent from the bottom of the stripper is pumped back to the extractors. Auxiliaries for the unit include recovery of solvent from wash water by distillation and a closed wash-water system for economic recovery of solvent.

The washed extract is fractionated to produce a heart-cut aromatics stream for aviation reformate. The remaining extract goes to motor reformate. The separation of aviation gasoline is made in a rerun column and stripper.

Feed condition . . . The extraction section requires that the feed be at a specified temperature for best results. Attaining the desired temperature is no problem when the feed comes directly from the bottom of the deheptanizer column in the reformer. With the prefractionation system on stream, however, the Udex extraction feed is the overhead product of the first prefractionation column.

Since this feed would be subcooled during periods of low throughput or cold condenser water, the overhead was designed with a special hot vapor bypass to bring the condensate to the desired temperature. The vapor bypass is arranged for countercurrent contact flow with the subcooled condensate from the condensers.

Four fractionating systems provided as auxiliaries for the Udex unit involve complete condensation of the overhead. All operate at atmospheric pressure or slightly above and all are large size, 8½ to 16 ft. in diameter. During emergency conditions, these systems could operate at a vacuum. But since the normal operation does not warrant a full vacuum design, the equipment in these systems is protected by flooding with inert gas whenever the pressure drops to the design point.

Design capacities for feed stock and products are summarized below. The design rates are not necessarily concurrent.

	B.P.S.D.
Feed to feed prep:	
Partially deheptanized reformate	35,000
Heavy cat gasoline from Train 3 desulfurizer	10,000
Products from feed prep:	
Feed to Udex extractor, up to	40,000
To motor-gasoline blending, up to	13,500
To No. 2 fuel storage, up to	1,500
Products from Udex extraction:	
Raffinate to reformer, up to	19,000
Extract, up to	21,000
Feed to rerun column:	
Extract from Udex extraction	11,500
Products from rerun column:	
Aviation reformate	2,300
To motor-gasoline blending	9,200

The license, process design, and basis for engineering of the Udex extraction section were by Universal Oil Products Co. The actual engineering, procurement, and construction were by C. F. Braun & Co. The feed-prep section and the aviation rerun facilities were all by C. F. Braun & Co.

THE Houdriformer Unit

. . . for plant's highest-octane blending stock

BY H. W. DAY

THE Houdriformer, largest catalytic reforming unit in the world, will produce the refinery's highest octane blending stock for both aviation and motor gasolines.

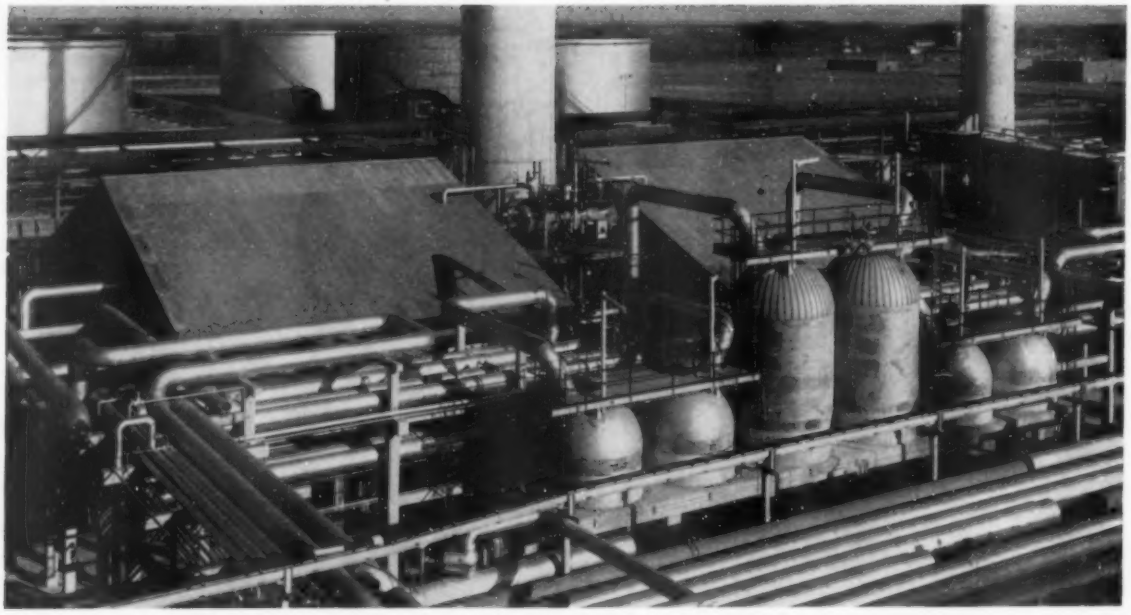
It is designed for a combined capacity of 45,200 bbl. per day, consisting of 30,000 bbl. per day of desulfurized fresh feed and 15,200 bbl. per day of paraffinic recycle from the Udex aromatics extraction unit.

Although the design basis for the Houdriformer is for a specific rate and composition of feed stock, the plant is engineered for economic operation with wide variations in feed quality and feed rates for several qualities of reformate.

Throughput variation . . . Through control of operating variability, reaction temperature, and space rate, plus the fact that the reformer is made up of two reactor trains, wide varia-

Author is chemical senior engineer, C. F. Braun & Co.

SPECIAL SECTION

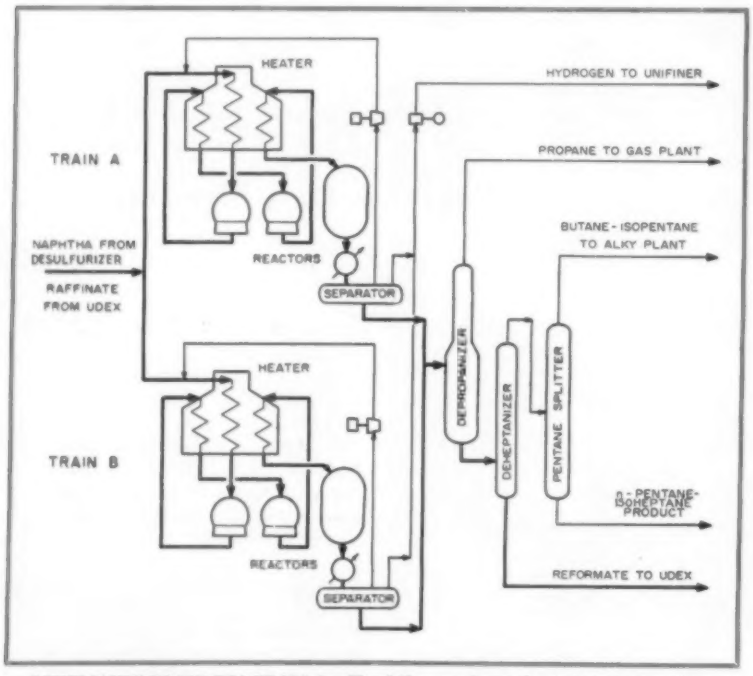


TWIN-TRAIN HOUDRIFORMING unit is used for the refinery's catalytic reforming operations.

tion in throughput is achieved. Other factors contributing to flexibility in the naphtha-upgrading section of the refinery include the desulfurizing section for feed pretreatment, as well as the Udex extraction unit for separation of the final high-octane product and raffinate for recycle to the Houdriformer.

The fixed-bed catalytic reforming process uses Houdry 3-D platinum-containing catalyst. Regeneration equipment is provided for regeneration of the catalyst in place.

The reaction section consists of two parallel trains. Each train consists of three downflow reactors, a heater with one preheat and two reheat services, a reactor charge pump, a recycle gas compressor, feed-to-effluent exchangers, effluent condensers, and an effluent liquid-gas separator. The unit is designed to operate at a pressure of 465 psig. in the separator.



SCHEMATIC FLOW DIAGRAM for Houdriformer shows the twin-train operation.

Size . . . The size of the unit can be appreciated by noting the size of some of the major equipment. Each heater has a total design duty of 156 million B.t.u. per hour. Each recycle compressor is 5,280 b.hp. Each train contains 14 exchanger shells over 40 in. in diameter. Feed and effluent piping around the heater and reaction section is 20-in. size.

Hydrogen produced from the reaction leaves the separator for make-up in the desulfurizer trains. Liquid reformate from the separators in the two parallel reaction trains is processed in one fractionation train. The fractionation train has three columns, all over 8 ft. in diameter. These are a depropanizer, a deheptanizer, and a 70-plate pentane splitter.

The deheptanizer cuts out the bottom portion of the reformate for economic operation of the Udex unit. Overhead from the deheptanizer is separated into two products in the pentane splitter. Bottoms from the pentane splitter go to motor reformate, and the overhead butane-isopentane is fed via tankage to the alkylation unit.

Under expected operating conditions, continuous operation for a year or more should be possible without requiring regeneration of catalyst.

SPECIAL
SECTION

Should operating conditions reach extremes of feed capacity, feed quality, and operation severity, the single manually controlled regenerating system may be employed as required.

Regeneration . . . Regeneration equipment includes an inert-gas regenerator, a caustic scrubber for the removal of CO_2, plus a compressor for charging the reactor with inert gas and, later, air during the regeneration. The large recycle gas compressor is used for recirculating regeneration gas. By the method of regeneration specified by the licensor, controlled burnoff of carbon residues that accumulate on the catalyst is achieved.

The reaction section piping is welded to equipment wherever practicable, to reduce costs and to minimize hydrogen leaks. This construction involves the reactors, heater coils, and exchanger shells. Piping to the exchanger-tube bundles, however, is flanged for tube-bundle replacement. In general, materials are steel throughout the reformer unit. The main exception is the hydrogen service above about 500° F. Here, materials are the usual 1 chrome ½ moly for piping, exchangers and reactor shells. Heater coils are 2¼ chrome 1 moly.

Flexibility . . . One of the important problems in engineering a large capacity unit is designing for flexibility at low feed rates. This is especially true in a catalytic process in which catalyst contact time affects yield structure. Fortunately for this consideration, engineering economics dictated a two-train reaction section. This automatically permits a 50 per cent reduction in feed rate without changing the design operating conditions. Also, by varying reactor temperature to compensate for catalyst contact time, total unit feed rate may be changed within wide limits.

The Houdriformer uses reactor effluent as a high-temperature heat medium to reboil the depropanizer in the fractionation section. Two reboilers are provided, one for each reactor train.

The depropanizer column loads must be kept above 40 to 50 per cent of the design load to maintain efficient operation. The column is kept loaded within the acceptable range by maintaining the recycle gas stream at design rates, even when operating at reduced naphtha charge rates. Keeping the recycle stream constant provides sufficient heat in the effluent stream for reboiling the column. With only one reformer train in operation, the depropanizer can always be loaded to about 50 per cent of design.

Design capacities for feed stock and products are summarized below:

Feed:	B.P.S.D.
Desulfurized naphtha from desulfurizer, Train 1	30,000
Paraffinic recycle from Udex unit	15,200
Products:	
Hydrogen-rich gas, mol. wt. 9.2, M.M.s.c.f.d.	29.5
Depropanizer off-gas to gas plant, mol. wt. 33, M.M.s.c.f.d.	7.40
Deheptanized reformate, 83-84 octane	31,600
Butane-isopentane	5,300
n-Pentane - isoheptane cut to motor gasoline	3,900

The Houdriformer was licensed by Houdry Process Corp. Houdry supplied heat and material balances for the reaction and regeneration sections, and the mechanical design of the reactors.

The engineering design, procurement of materials and equipment, and construction, were by C. F. Braun & Co. The engineering design included such things as the economic selection of the number of reactors, reactor trains, extent of feed-effluent exchange, and the amount of furnace preheat. The complete fractionation section was by C. F. Braun & Co.

THE Desulfurizer Unit

. . . Five separate trains for removing sulfur

BY H. W. DAY

ONE of the main features of the Tidewater refinery is its ability to process crudes high in sulfur. The product streams from such crudes frequently carry more sulfur than refined products can tolerate even after normal treating and blending.

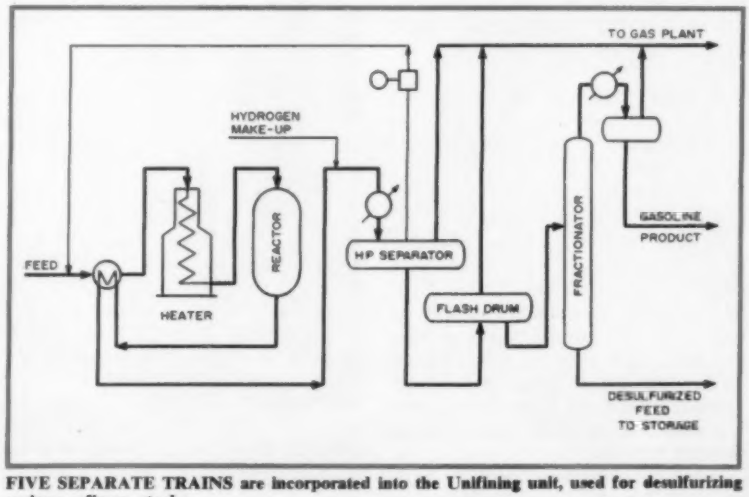
The Unifining unit removes the objectionable sulfur from the high-sulfur streams. The treated streams then can go into blends for further processing or for final products. The unit comprises five separate trains. The arrangement of these trains permits each one to treat a different feed stock and produce separate products.

Alternately, the trains can combine fractionation cuts that have similar properties. Operating independently, the trains normally desulfurize the following stocks:

Train	Stock—
1	Intermediate naphtha and coker gasoline for charging the catalytic reformer.
2	Virgin distillate.
3	Raw heavy gasoline from the catalytic cracker.
4	Light virgin gas oil.
5	Coker light gas oil and catalytically cracked raw light gas oil.

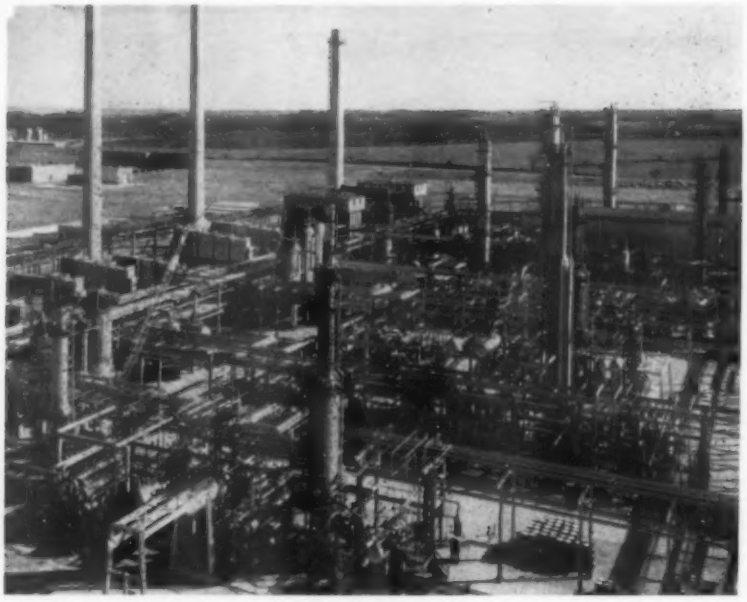
Author is chemical senior engineer, C. F. Braun & Co.

SPECIAL SECTION



FIVE SEPARATE TRAINS are incorporated into the Unifining unit, used for desulfurizing various refinery stocks.

SPECIAL SECTION



TRAINS 2 THROUGH 5 of the desulfurizer unit, with fired heaters to the left. Hydrogen plant is in the background.

Processing facilities . . . Although each train differs in some respects from the others, they all possess the following comparable processing facilities.

1. A furnace for preheating the feed.
2. One or more reactors using a cobalt-molybdenum catalyst.
3. Heat exchange between feed and reactor effluent.
4. A water-cooled effluent condenser.
5. A product separator to remove condensed material from the hydrogen recycle gas.
6. Equipment for hydrogen purge or makeup to control hydrogen composition.
7. A flash drum and fractionator to recover the specification liquid product and the light ends from the offgas.
8. Water injectors to assist the purging H_2S and NH_3 as a solution of ammonium chloride and ammonium sulfide.
9. A charge pump.
10. A recycle-gas compressor.

In addition to the facilities common to all trains, some of the trains have other specific facilities. Trains 1, 2, and 4 each have feed strippers to remove air from stocks that have been exposed. Each train has a water draw at the flash drum, ahead of the fractionator, to prevent water formed during desulfurizing from contaminating product streams.

Train 5 uses a feed drum for heater surge for the liquid coils and to blend the two liquid feed stocks. Train 5 has an amine scrubber for the recycle gas to keep the H_2S content down, and the reactors are arranged in parallel because of the large flow rates of both gas and oil streams.

Process flow . . . The flows through the various reactors and reactor circuits differ. Trains 1, 2, and 3 each have two reactors in series. Train 4 has one reactor. Train 5 has two reactors in parallel.

Heaters range in duty between 20 and 35 M.M. B.t.u. per hour. Recycle-gas compressors are reciprocating in Trains 1 through 4, and centrifugal in Train 5, where the duty was enough to warrant the centrifugal.

The desulfurizer trains are integrated mainly to combine the gasoline streams from the five fractionators. The fractionator overhead from Trains 2 and 4 feeds to the flash drum in Train 1. The fractionator overheads in Trains 1 and 5 feed to the flash drum in Train 3. The normal operation of the Train 3 fractionator recovers a heavy aromatic gasoline that is further trimmed for processing in the Udex feed-prep unit. The heavy-aromatic cut goes to motor-gasoline tankage from the Udex feed-prep unit. The overhead from the Train 3 fractionator feeds back to the gas plant. Other tie lines and connections between trains provide for modifying operations when other process units are down.

The process design was supplied by Universal Oil Products Co. The engineering, procurement, and construction were by C. F. Braun & Co.

THE Hydrogen Plant

. . . will upgrade intermediates and products

BY J. V. CLASS

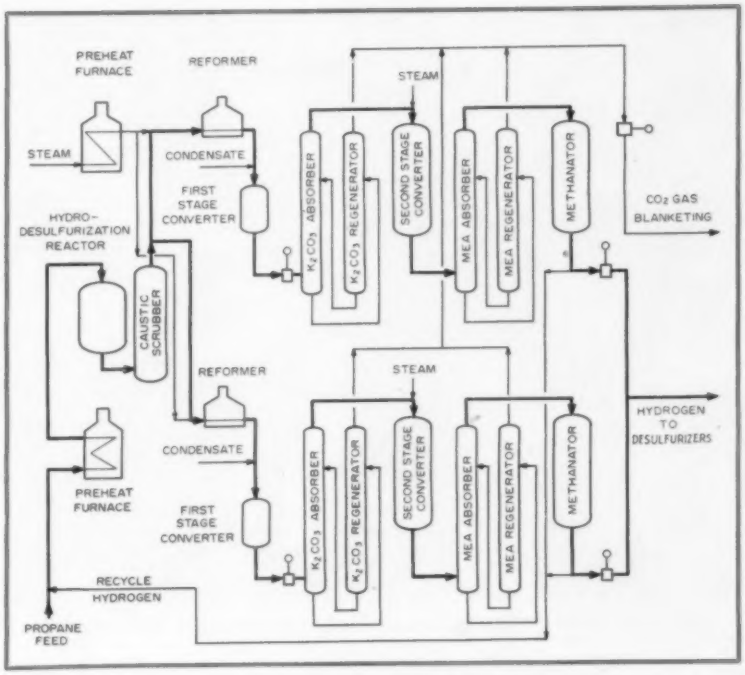
LAST of the process units to be put into operation in the Delaware refinery, will be the 30-M.M.s.c.f.d. hydrogen plant. This unit, one of the largest of its kind, is further evidence of Tidewater's over-all plan for the production of highest quality petroleum products from high-sulfur, heavy crudes.

At the refinery, Tidewater uses hydrogen treatment to upgrade several refinery products and intermediate fractions. The nature of the improvement and the amount of hydrogen required, depend upon the particular product. The improvement can be lower sulfur content, greater stability, better color, better odor, or a combination of several of these.

Author is chemical senior engineer, C. F. Braun & Co.

Capacity . . . Largely because of the high sulfur content of the crude oil which the refinery is designed to process, there is a deficiency in the amount of hydrogen produced as a byproduct of catalytic reforming in relation to the amount required for treatment of products. For one of the crude-oil blends used as a basis for the refinery design, the hydrogen deficiency amounts to 30 M.M.s.c.f.d. This quantity establishes the design capacity for the hydrogen plant.

Unusual features . . . Several impor-



SIMPLIFIED FLOW DIAGRAM for the hydrogen plant.

ONE OF TWO parallel hydrogen trains for the hydrogen plant.

tant factors, in addition to the large capacity, dictated the hydrogen plant design. First, the number of products requiring hydrogen treatment set the need for a high service factor. Second, the relatively high value of manufactured hydrogen required a flexibility to meet widely varying hydrogen demands. And third, efforts to minimize utility requirements resulted in the selection of a process employing high-pressure reforming, and carbon dioxide removal by high potassium carbonate scrubbing.

After analysis of these requirements, the anticipated refinery turnaround schedules, and the various cost factors, the engineers concluded that the hydrogen producing capacity should be installed in two essentially parallel units, each with 15-M.M.s.c.f.d. capacity, with each designed to operate efficiently when producing at rates as low as one-fifth of design.

Feed . . . Hydrogen can be produced by reforming hydrocarbons, with natural gas, refinery fuel gas, and ethane streams being commonly used. But the Delaware refinery has neither natural gas nor an ethane stream available. The refinery fuel gas is not acceptable because of its nitrogen content. For these reasons, a refinery propane stream provides hydrogen plant feed.

The propane stream meets L.P.G. specifications. It contains some unsaturated hydrocarbons, largely propylene. If other hydrocarbon streams become available in the future, some of these could be substituted for propane without a major modification of the plant and with relatively small changes in capacity.

Hydrodesulfurization . . . The hydrodesulfurization section performs a dual purpose. It converts propylene in the feed to propane, thus reducing the tendency to form coke during subsequent reforming. And it converts sulfur compounds to hydrogen sulfide which is removed by caustic scrubbing.

Reforming . . . Two furnaces operated in parallel produce a gas stream containing hydrogen, carbon monoxide, carbon dioxide, and steam—by reacting treated propane feed with superheated steam. The reaction proceeds in catalyst-filled vertical tubes at about 125 psig.

Hydrogen purification . . . The gases leaving the reformers at about 1,450°

SPECIAL SECTION

F. are first cooled by injecting condensate, then flow to first-stage shift converters. Here the reaction of carbon monoxide with steam forms carbon dioxide and hydrogen. After compression to 300 psig., most of the carbon dioxide in the gas mixture is removed by scrubbing with hot potassium carbonate solution.

The gases are then mixed with steam and sent to second-stage shift converters to form additional hydrogen by converting carbon monoxide to carbon dioxide. The carbon dioxide formed in the second-stage shift converters is removed by scrubbing with monoethanolamine solution.

Most of the remaining carbon monoxide and carbon dioxide is removed by reaction with a portion of the hydrogen product in methanators. After compression to approximately 800 psig., the hydrogen product supplies the need of the Unifiners.

The plant manufactures hydrogen of 95 mole per cent purity.

Utilities . . . Utilities required for the production of 30 M.M.s.c.f.d. of hydrogen are as follows:

TABLE 1

Steam produced, M.M. lb. per day	2.5
Steam used, M.M. lb. per day	5.6
Fuel gas used, M.M. B.t.u. per day	7,000
Cooling-water circulation rate, M.M. gal. per day	30
Electricity, kw.	4,700

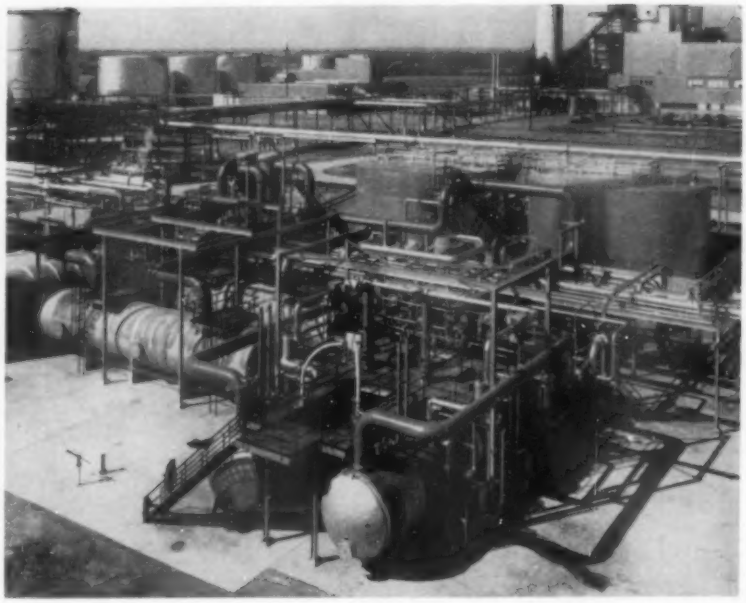
Materials of Construction

Special materials of construction are used in three general locations throughout the hydrogen plant. The first of these is for equipment subjected to attack by hydrogen at elevated temperatures and high partial pressures. The second is for equipment subjected to corrosion by moist carbon dioxide. And the third is for tube-side parts of coolers and condensers in contact with salt water.

A steel alloy containing chromium and molybdenum is most generally used in the first of the above locations. However, because of the high-temperatures encountered, the effluent piping from the reformers is fabricated of Incoloy. Corrosion by moist carbon dioxide has been minimized in critical locations by the use of aluminum and in some instances monel.

For the most part, the tube-side parts of coolers and condensers follow the set pattern used in salt water service throughout the refinery.

The feed pretreating and reforming sections were designed by Girdler Co., and the hydrogen purification section was designed by C. F. Braun & Co. All construction was by Braun.



SULFUR RECOVERY PLANT processes waste hydrogen sulfide from sour crudes.

THE Sulfur Plant

. . . Contributes to economy; public relations

BY J. M. PHELPS

THE largest sulfur-recovery plant ever built makes an important contribution to the economy of the Delaware refinery. The refinery is designed to process some very low-grade crudes, with sulfur contents running as high as 5 wt. per cent. Most of the sulfur compounds are converted to hydrogen sulfide during the refining operations and separated in the DEA absorption section of the gas plant.

The sulfur plant processes the stream of hydrogen sulfide gas collected from the various desulfurizing operations, and accomplishes a dual purpose. It recovers high-purity elemental sulfur as a valuable byproduct and it removes a source of atmospheric pollution.

When the refinery is operating on high-sulfur heavy crudes, sulfur production may reach 340 long tons per day. But the plant must be flexible in order to produce less than one-fifth that amount when the refinery charges low-sulfur crudes.

Author is senior engineer, C. F. Braun & Co.

SPECIAL SECTION

H_2S combustion . . . Sulfur is recovered from the gas stream by controlled combustion of a portion of the hydrogen sulfide with air in a reaction furnace. Such furnaces have a lower limit of effective operation. A study of refinery balances showed that under some conditions a single large furnace would not be efficient, and that two smaller furnaces operated in parallel would provide the necessary flexibility.

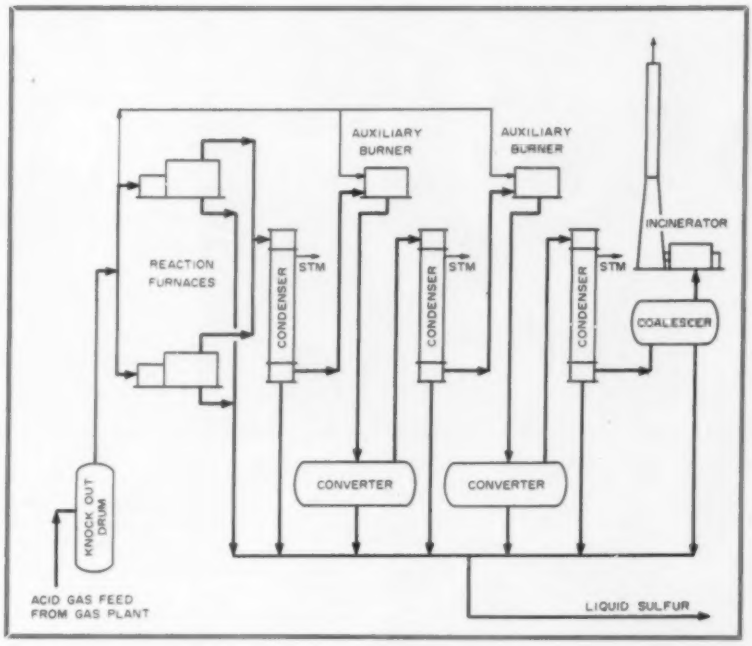
The combustion reactions are as follows:

$$2\,H_2S + 3\,O_2 \rightarrow 2\,SO_2 + 2\,H_2O$$

and then

$$2\,H_2S + SO_2 \rightarrow 3\,S + 2\,H_2O$$

The hot combustion gases pass over a bank of tubes in each furnace and generate 175-psig. steam in the tubes. The two hot-gas streams combine after leaving the furnaces to flow through the remainder of the unit as a



SULFUR PLANT FLOW DIAGRAM shows the processing of acid gas to produce liquid sulfur.

SPECIAL SECTION

produced in the furnaces, the converters, the condensers, and the coalescer. The sulfur is withdrawn through steam-jacketed lines and accumulated in two insulated storage tanks. Economics dictated that the tanks should be of steel, aboveground, rather than underground concrete vats as is the usual practice. From the storage tanks, the molten sulfur is pumped to insulated tank cars and tank trucks for shipment.

The plant operates at a high rate of conversion. It generates steam for its own use and puts excess steam into the refinery steam system. An analysis of feed and sulfur products and utilities consumption appears in the tables. Licensing and processing were by Ralph M. Parsons Co., and procurement and construction by C. F. Braun & Co.

1. SULFUR PLANT—FEED

Hydrogen sulfide, vol. per cent	80.8
Carbon dioxide, vol. per cent	12.7
Hydrocarbons, vol. per cent	1.9
Water, vol. per cent	4.6

2. SULFUR PLANT—PRODUCT

Sulfur, commercial yellow, wt. per cent	99.5+
Moisture, wt. per cent	0.10
Organic material, wt. per cent	0.02
Ash, wt. per cent	0.01

3. SULFUR PLANT—UTILITIES

Power, kw.	20
Boiler feed water, g.p.m.	200
Net steam produced:	
175 psig., lb./hr.	50,000
40 psig., lb./hr.	40,000

single train. The gases are cooled in a condenser to generate 40-psig. steam.

Next, the gases are reheated in an auxiliary burner and passed through a catalytic converter where additional sulfur is produced. A second condenser cools the gases and generates more steam. Again the gases are reheated and passed through a second-stage converter and a third condenser. Residual gases flow through a coalescer, and any residual sulfur compounds are burned to sulfur dioxide in an incinerator before discharging to the atmosphere.

Sulfur recovery . . . Liquid sulfur is

Gasoline, Fuel Blending

. . . A continuous, largely automatic process

BY R. N. WIMPRESS

THE blending of finished base stocks into final products is a continuous in-line process, largely automatic in operation. In comparison with the older batch-blending methods, the continuous process is faster, it reduces the inventory of stocks in process, and it allows better control over final composition.

The design provides for flexible operation to meet present and anticipated future needs. The extensive use of automatic controls improves reliability and minimizes manpower requirements.

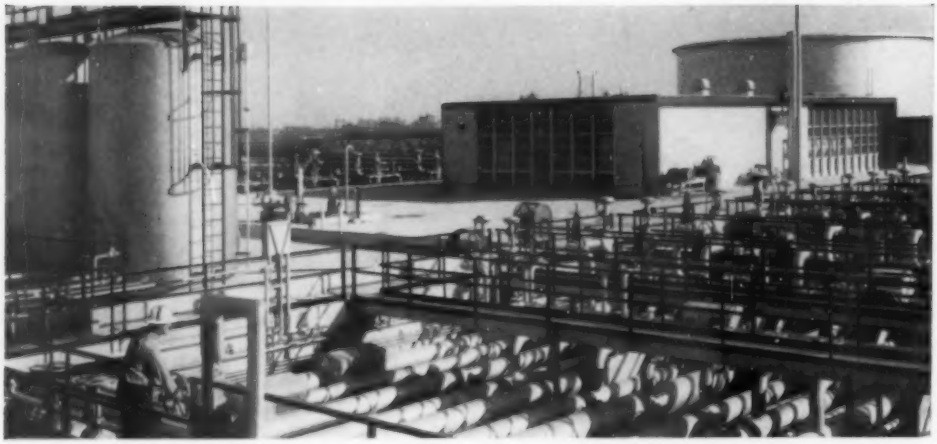
Three blenders . . . There are three blenders for distillate products. One, for gasoline, has capacity for seven components at a total product rate of 10,000 bbl. per hour. Another, for No. 2 fuel oil, will handle five components, also at 10,000 bbl. per hour. The third, for distillates such as kerosine, diesel fuels, and jet fuel, can blend three components at 4,000 bb. per hour.

Author is senior chemical engineer, C. F. Braun & Co.

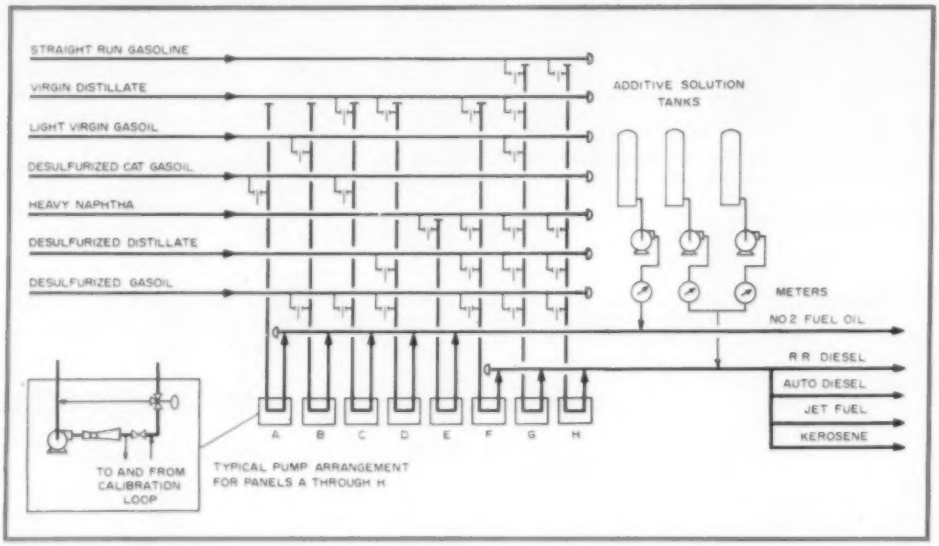
In addition, each unit has facilities for adding tetraethyl lead, dye, stabilizer, or similar additives as required. All three of these blenders are controlled from graphic panels located in a central control house.

In the gasoline blender, 11 pipelines, of from 8 to 16-in. size, run from the base-stock storage tanks to the blending area. They supply materials ranging in volatility from butane to heavy gasoline. Seven pumps, manifolded to these lines, circulate the base stocks through the blender and on to final product storage. Flow rates are measured with venturi-type flow tubes and pneumatically transmitted to the graphic control panel.

Control house . . . Inside the control house, the desired percentage of each component, its specific gravity, and the desired blending rate are set in the graphic panel. When blending starts, the flow of each component is automatically corrected for gravity, integrated, and shown in a batch counter. The total product flow is continuously displayed on a strip-chart

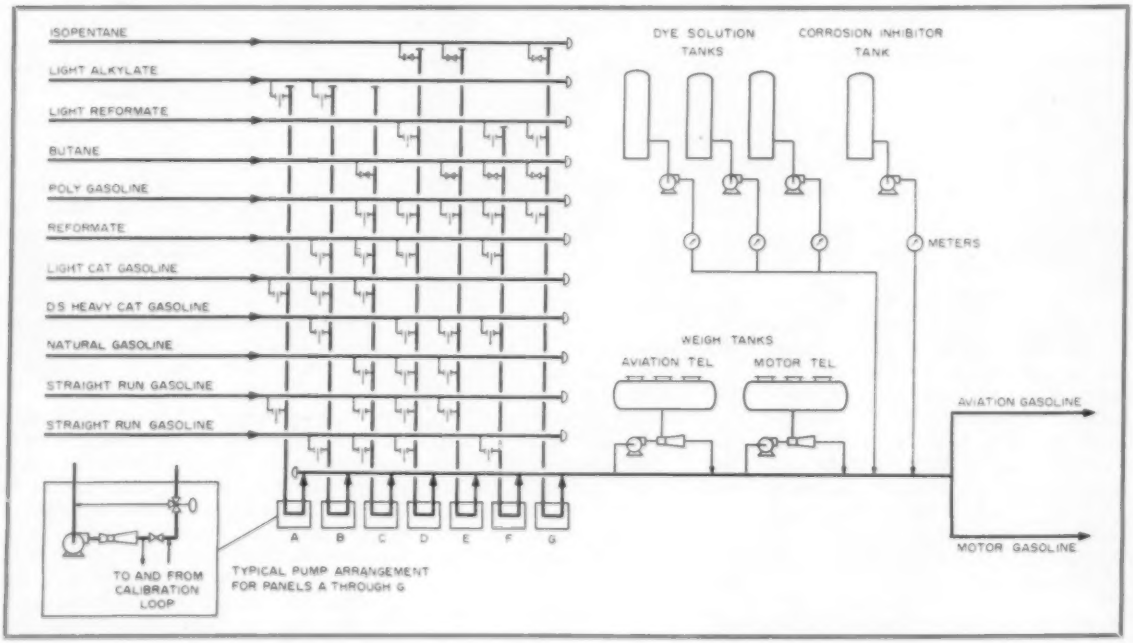


IN-LINE BLENDING FACILITIES provide for the proper blending of all fuel products.



FUEL OIL blending is done according to this flow pattern.

GASOLINE blending is carried out according to this simplfied flow sheet.



recorder, in addition to being integrated and shown on batch and cumulative counters.

The total blending rate can be changed at any time to meet production requirements without disturbing the percentage settings for the components. The batch counter can be preset to automatically stop the blending operation when the desired amount of product has been made.

After the primary blending, the gasolines receive tetraethyl lead, dye, and corrosion inhibitor. By automatic control the flow of each additive is proportional to the total blending rate. The products then travel either to final product storage tanks or directly to ships at the piers.

Safeguards . . . Numerous safeguards insure continuous product quality. The performance of each component supply and measuring system is checked in recycle operation before blending is started. During blending the actual flow of each component and the rate of tetraethyl lead addition are continuously machine-compared with the values specified by the master controller.

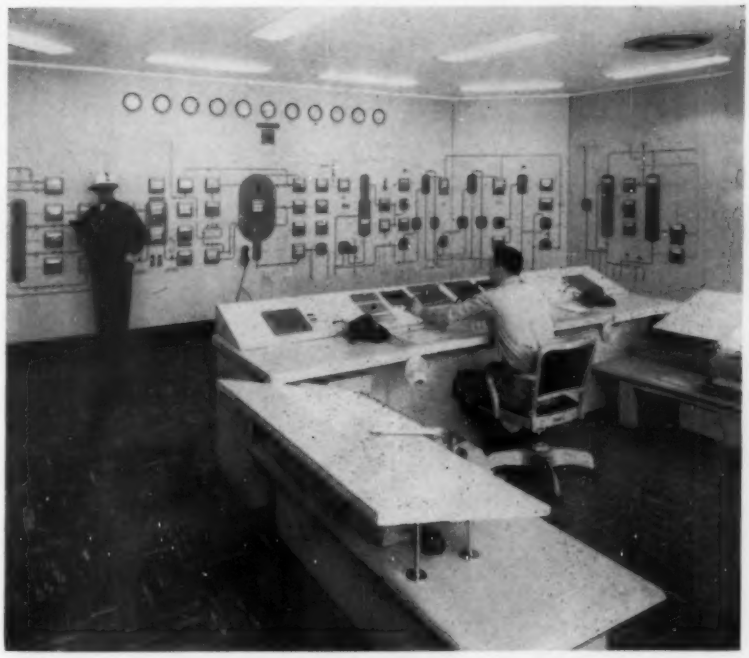
Any deviation beyond preset limits automatically stops the entire blending operation. A master shutoff switch on the central control board and a similar switch at the marine terminal can shut the whole area down in a sudden emergency.

A calibration loop installed adjacent to the blending area facilitates frequent checking of the venturi meters. The loop consists of a 1,000-ft. run of 8-in. pipe, manifolded so that it can be connected in series with any of the component flow meters. To calibrate a meter, a standard batching pig is launched into the upstream end of the loop.

The pig actuates electrical contacts at each end of the proving section. The electrical impulses start and stop the batch counter on the meter being tested. Comparison of the recorded volume with the known volume of the proving section provides a direct calibration of the meter.

No. 6 fuel oil is blended in a separate installation. Gas-oil cutter stock is added to vacuum residium from the crude unit, and the viscosity of the mixture is measured with a continuous recording viscosimeter. Output from the viscosimeter is used to control the flow of cutter stock to meet viscosity specifications.

The blending equipment was designed and supplied by Proportioneers, Inc., the lead handling by E. I. du Pont de Nemours & Co. Engineering, design, and construction of the facilities were by C. F. Braun & Co.



CRUDE UNIT CONTROL ROOM is typical of the seven process-unit control rooms.

Instrumentation

. . . Three reasons dictated pneumatic type

BY W. C. GARDNER AND J. E. LEARY

MODERN instrumentation plays an important part in the design and operation of the refinery. Early discussions between Tidewater and Braun engineers established a basis for selection and application of instruments throughout the refinery. Uniformity of instrument types and application reduced the problems of engineering, purchasing, installation, commissioning, and maintenance.

Pneumatic instrumentation was selected for three reasons. (1) The control houses are centrally located. With this arrangement, the average transmission distance is about 250 ft. (2) Speed of response is not critical for control of the processes involved. (3) For this refinery, pneumatic instruments were economically attractive.

There are nine control rooms—the nerve centers of refinery operation. Seven control rooms serve 11 process units. One control room serves the utilities unit. And one is for the tank-farm and products-blending operations. Some 400 miles of copper tubing ties the control-room instrumentation to the locally-mounted instruments throughout the plant.

Approximately 80 per cent of the tubing is in the form of multitube cables with 4, 7, 12, and 19 copper tubes per cable. The installation time for long tubing runs was markedly decreased by the use of the cabled tubing.

New concepts . . . The newest techniques in process instrumentation have been utilized within each control house. Two major assemblies, a control board and an information system, form an integrated system of instrumentation in each control room.

Process control is centralized on the control boards. Graphic panels are provided for all refinery units except the utilities unit. All board-

Authors are chemical engineers with C. F. Braun & Co.

SPECIAL SECTION

mounted instruments are miniature pneumatic receivers.

Information Systems

The information systems continuously and automatically present an up-to-the-minute picture of unit operation. Each system consists of a data-handling system which is directly connected to the measuring elements throughout the process.

These information systems represent the largest installation of their kind in the process industries. There are a total of 13 systems—one for each process unit plus a special logger-computer for the tank farm.

Capacity is provided for 4,000 points. The largest of the systems has a capacity for 600 points, the smallest 125 points. Inputs are pneumatic and electrical signals for flows, pressures, temperatures, levels, and other process variables.

Output . . . The output data from each system appear in four ways; on log sheets, on digital indicators, on trend recorders, and on punched paper tape. Once an hour, from 72 to 216 points are normally logged on each log sheet. Space is provided for 24 hourly logs plus 12 on-demand logs.

Logging is at the rate of about one point per second. Every point is logged in red, whenever it goes beyond preset limits. It's logged in black upon return to normal. Off-normal scanning is at the rate of five points per second. This provides the operators with a continuous picture of the effectiveness of the control over the unit.

Once a day a summary of unit operation is logged in the accounting section of the log sheet. This summary shows daily averages of critical temperatures and pressures and daily totals of important flows.

Each point is identified on the jack panel in the center of the console. The appropriate plug is selected to connect any point to either a digital indicator or a trend recorder. One point at a time can be connected to each digital indicator. From one to four points can be connected to each trend recorder. The trend recorders are located directly behind the operating console.

A daily summary of unit performance is recorded on punched paper tape. The same totals and averages that are printed in the accounting section of the log sheet are coded onto the tape. The tapes from all information systems are available to a central data-processing facility.

In a matter of minutes, an accurate plant-wide report will summarize refinery operations for the past 24 hours. This summary shows averages for important temperatures and pressures, the feed stocks and utilities consumed by each unit, and the products made.

THIS INSTRUMENT CUBICLE is directly behind the operating console.

Tank farm . . . The tank farm consists of 88 tanks with a storage capacity of some 7,600,000 bbl. A special information system presents a variety of data for each tank. Inputs to the system are electrical signals from level transmitters and resistance bulbs at each tank.

The tank farm information system provides output data in three forms: a log-sheet, a digital indicator, and punched paper tape.

A complete inventory of all 88 tanks will be automatically logged every 8 hours. The data for any one tank can be logged at any time. Logged information for each tank includes time, tank number, tank fluid, fluid gravity group, level in feet and hundredths of a foot, temperature, and barrels corrected to 60° F. The tank fluid and fluid gravity group are manually preset for each tank.

A special digital computer determines the corrected barrels based on the measured level, the measured temperature, tank-strapping tables, and a computed expansion factor for the specific tank fluid. A complete log of all tanks, including computation time, can be made in from 8 to 15 minutes.

The digital indicator shows tank level and temperature only. The logged data are duplicated on punched tape. This tape goes to the central data-processing facility. The tank inventories can then be quickly incorporated in the refinery-wide report based on the output from the 12 other information systems.

SPECIAL

SECTION

Planning

Early planning permitted design of the control boards, information systems, and control houses as an integrated whole. A series of meetings early in the project attained close cooperation between Tidewater, Braun, and Panellit. This planning obtained maximum utilization of the systems. Only the most important points are duplicated on both the control board and the information system. And the control houses were designed around the instrumentation.

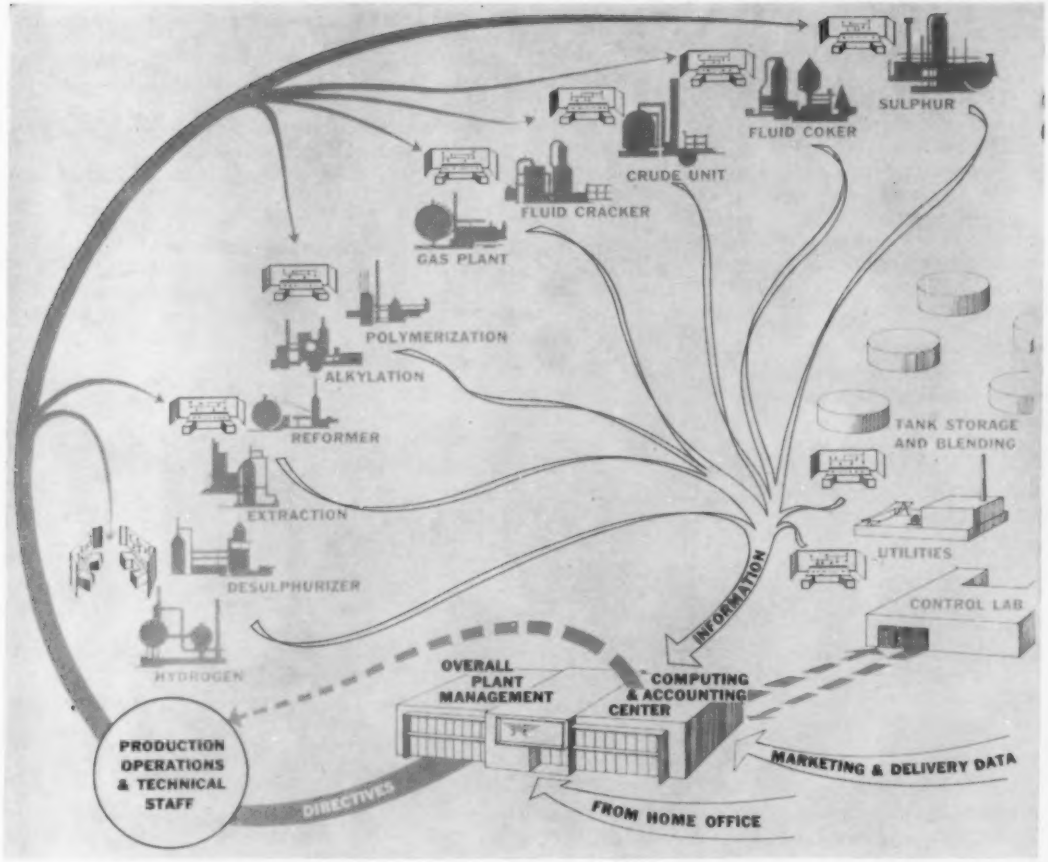
The decision to install the information systems throughout the refinery was based on several factors. From an economic standpoint, the systems pay out in 2 to 3 years based on three savings: 1. By eliminating many instruments and by using some indicating rather than recording instruments, the control boards are simplified. The control boards would have averaged some 25 per cent longer without the information systems. 2. By eliminating the routine hourly logging and recording of off-normal conditions, the operator's time can serve better purposes. 3. By using daily-summary tape in connection with central machine accounting, clerical manpower is reduced. Averaging, totalizing, and summarizing become automatic—from the point of measurement, to the final report.

Advantages . . . The information systems offer other advantages which are not readily evaluated in dollars and cents. A record of off-normal conditions is automatically made during a process upset. These records can be analyzed later in order to evaluate the cause and effect of the upset.

The systems provide up-to-the-minute process data. For example, 300 points can be automatically logged in 4 minutes. Manual logging would require close to 30 minutes—and then the first and last variables logged are not comparable time-wise. Continuous scanning provides an invaluable aid to the operators in maintaining effective control.

The daily operating summary will be available for the entire refinery at the start of each day. The operating data will be immediately available to accounting, engineering, and management. Decisions to alter the operations can be made promptly, based on accurate data.

The information centers and control boards were designed and supplied by Panellit Corp. The engineering, design, and construction of the over-all installation, were by C. F. Braun & Co.



New information systems make plant an . . .

Automation Pacemaker

IN addition to the many "firsts" which distinguish the new Delaware refinery of Tidewater Oil Co., the plant is the pacemaker in the advancing technology of automation in the field of petroleum refining.

Panellit, Inc., designed, built, and installed the information systems. The company will also maintain the instrumentation facilities at the new refinery.

The function of the information system is to bring to each successive echelon of management, exactly that information which it needs—and no more. The information, moreover, must be presented to each echelon in usable form, and it must be made available in time to be of maximum value in directing the operation of the plant.

Continuous automatic scanning, data reduction, and logging supply each echelon of the organization, from operators to top management, with the desired information by the minute, hour, and day, according to the need. This information comprises both continuing and periodic status reports on more than 5,000 variables of temperature, pressure, flow, and equipment condition.

Logging . . . But the benefits of this vast system of data handling would be lost if the thousands of instruments had to be read, and corrective action taken from the readings. Machines had to be designed to take over as much of the job as possible, to check the measurements, to selectively call attention to off-normal conditions and to log or record the types of data which must have study and evaluation to form a sound technical foundation for efficient refinery operation and management.

The basic purpose of the instrumentation is to extend the capabilities of the men who run the plant, to enable them to make the type of decision which will optimize production from the huge complex of vessels and piping which make up the modern refinery.

The system is designed to provide flexibility in control and to allow for process modification and expansion, but every piece of data generated and transmitted must stand the test of need.

SPECIAL SECTION

One of the governing principles in designing the system was that data be transmitted no farther than necessary and that reduction or processing of data required on a continuous basis be done at the point nearest the operation being monitored.

The objective is to provide the man directly in charge of any unit with the current information he needs to do his job, and to relay on to the technical and operating heads of the plant, only that information which is useful to them.

Operations leader . . . The point of direct control of a process is the unit operations leader at the control console. His job is to watch for malfunctioning of equipment and assure safe operation. In addition, he adjusts controller settings at the panel board to overcome deficiencies and keep the unit on stream. He also receives instruction from the operating superintendents and technical staff to maintain efficiency and quality control, and he operates the unit for which he is responsible in accordance with management directives.

These leaders are also served by high-speed continuous scanning equipment which cyclically checks from 300 to 500 or more instrumentation points. Every hour on the hour the machine makes a record of the reading of every instrument. At any time, the unit leader can get a special reading of each of these instruments, or just those which may be reading off-normal.

The plant instrumentation gives an alarm to call attention to any instrument which may be reading off-normal. The system permits a check on the proper functioning of the instrument itself, and of the data-transmission circuits.

On the unique Tidewater chart or log of each unit, readings from any instrument which is off-normal print in red. In addition, the machine logs on a special section of the chart, just those readings which are off-normal.

The 13 information systems will be located in nine process-unit control rooms. Each will supply a daily tape to a central information center where extensive processing will be done by electronic computer. This information center will provide the operating and technical heads as well as top management with the information needed for efficient operation of the refinery.

Maintenance . . . Panellit Service Corp. will handle instrument maintenance under contract with Tidewater. This calls for more than just the care and repair of instruments. Preventive maintenance is also necessary.

Further, an important phase of this type of maintenance work will be a constant program to upgrade the input data. The first stage of the Delaware refinery project is to get the production units on stream and operating satisfactorily. But work is already under way on the continuing job of upgrading input data to the information system to a level of accuracy and dependability which will provide a sound basis for computation and further processing.

Contracted maintenance assures Tidewater of an adequate and competent force at all times. A very high order of specialized skills is required for this work. Under a maintenance contract the management is relieved of the burden of recruitment and training. Flexibility of manpower is available, without repeated expansion and reduction of the plant forces.

Thus, a pool of maintenance specialists is available, on call, to the refinery. This is a service of special significance during the startup and debugging period of a new plant. After the initial manpower demand has been met, the maintenance force can be adjusted to meet normal requirements.

THREE GUARD BASINS and A.P.I. separator prevent oil from reaching the Delaware River in the refinery waste water.

Four separate systems needed for

Cooling Water

BY H. P. EVANS AND E. E. ELLIOTT

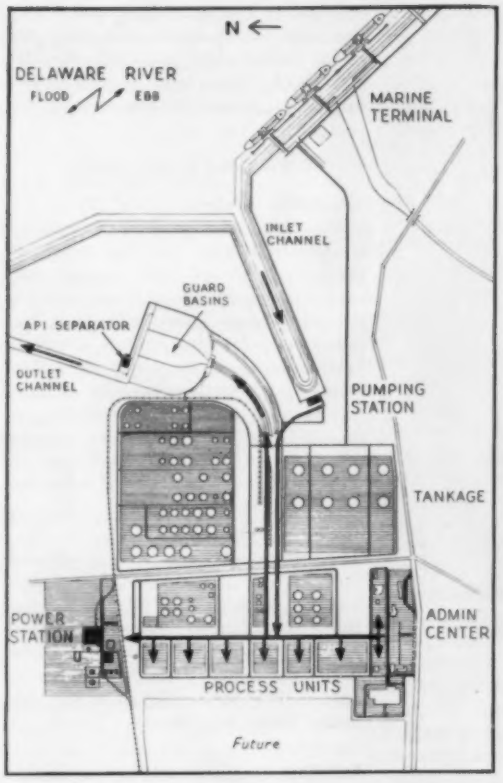
THIS 130,000 bbl. refinery and its adjacent 50,000-kw. power plant, require four separate systems to satisfy their needs for water. One system supplies river water for cooling.

Authors are, respectively, consultant, and project senior engineer C. F. Braun & Co.

SPECIAL SECTION

Water from wells is used in the other three systems which supply drinking water, raw water, and treated water. Of the four, the cooling-water system is of special interest due to the unusual provisions made to assure an unfailing supply along with operating flexibility and economy of first cost and operation.

Then, too, the use of brackish water, the quantity of cooling water, and soil conditions all introduced unusual problems in design and con-



FLOW PATTERN for cooling shows 5-mile travel of water from the Delaware River.

PUMPING STATION is the heart of the 275,000-g.p.m. cooling-water system.

struction. Salinity of the Delaware River is sometimes as high as 25,000 p.p.m.—equal almost to that of sea water. The 275,000 g.p.m. of cooling water used by the refinery and its power plant approaches the water consumption of a huge metropolitan area such as Philadelphia or Detroit.

1. Choice of Cooling System

Three alternatives . . . Sufficient cooling water had to be circulated to remove a heat load of 3 billion B.t.u. an hour. Engineering studies and cost analyses were made to compare three different arrangements for continually removing this heat. One, the fresh-water method, contemplated circulating well water in a closed system with forced-draft towers for cooling. The estimated loss of 9,000 g.p.m. by evaporation and blowdown was too great a load on the underground water supply, considering all the other demands on this source of water.

Another contemplated the use of a closed system with cooling towers but circulating river water instead of fresh water. With this method, salinity would be increased to 50,000 p.pm. and manufacturers were unwilling to guarantee the performance of the towers.

The third arrangement contemplated pumping the river water through the cooling system without any recirculation, thus eliminating the cooling towers. Studies showed this once-through method was less costly than the river water with cooling towers. It was adopted as the most reliable and most economic system.

Layout and flow . . . The general arrangement and flow diagram for the once-through system are in the accompanying figure. A dredged intake channel, about a mile and a half long, takes water from the Delaware River to the forebay of the pumping station. In the forebay, moving screens stop debris, and injections of chlorine limit the growth of algae and slime.

Nine 2,000-hp. pumps, all electrically driven, and each with a rated capacity of 34,400 g.p.m., lift the cooling water through two parallel 78-in.-diameter concrete pipes to the process units and to the power plant. Header length is 4,000 ft. Lift to the highest equipment is 75 ft. The water then passes to the various units where it circulates under pressure through condensers, coolers, and like equipment.

SPECIAL SECTION

Return . . . A collection system paralleling the process units for some 4,000 ft., picks up the return water and brings it to two 84-in.-diameter concrete pipes leading back toward the river. From the 84-in. return lines, the water flows by open channel into three huge guard basins, each 400 ft. wide and 1,000 ft. long. Normal operation of the refinery does not contaminate the cooling water, but these guard basins insure that oil from accidental leaks will not reach the Delaware River.

All oily water is skimmed off at the guard basins and carried to a gravity-type separator. Oil recovered at the separator is pumped back to the refinery for processing. The clear water from the guard basins and from the separator, flows through an outlet channel to again reach the Delaware River after its journey of more than 5 miles.

2. Design Requirements

This cooling-water system is a key factor in the operation of the entire refinery. Since practically all of the

refining processes are continuous, a failure of water supply would cause an immediate shutdown of part or possibly all of the refinery. The resulting loss of production would be very costly. Thus, special steps were taken to make the system reliable, flexible, and durable.

Reliability . . . A high degree of reliability is built into the system by the careful selection of equipment, by paralleling conduits and certain equipment, by providing spares for the most essential equipment. Standby power is provided. Vital equipment can be maintained and repaired without a complete shutdown. For example, at the pumping station, any of the moving screens can be isolated for maintenance without cutting a single pump out of service. All parts of the system, except the inlet channel, the outlet channel, and the separator, are built in multiple. Continuity of power to the pumps is assured by two sources of electric power, and by the use of dual feeders to the two substations.

Flexibility . . . Flexibility of operation, particularly during the startup and shutdown of process units, was a prerequisite. Based on the planned turnaround schedule, demand for cooling water may vary from as little as 140,000 g.p.m. up to the 275,000-g.p.m. design figure. The use of nine pumps, dual headers, dual return lines, three guard basins, and properly located valves, provide for practically every eventuality.

Durability . . . The river water of high salinity called for particular attention to the durability of the system. Alloys protect against corrosion of the screens, pump parts, strainers, in all of the heat-exchange equipment, and elsewhere. Steel pipe is lined with concrete. Surge tanks and check valves protect against water hammer. The lining of open channels protects against hydraulic scour.

3. Thermal Tests

Temperature rise . . . The tidal condition is such that there is no permanent upstream or downstream. The upstream current at flood tide and the downstream current at ebb tide, are essentially the same—roughly 2 ft. per second. And most of the river-flow occurs away from the refinery, in the channel east of Pea Patch Island. These conditions caused some concern at first as to the possibility of the river causing a short circuit in the cooling system by returning the discharged warm water back to the inlet channel.

Model tests . . . Under these conditions, little or no reliance could be placed on a judgment estimate of the water-temperature conditions in the river. Arrangements were made with the Corps of Engineers for hydraulic model tests to be conducted at their Waterways Experiment Station at Vicksburg, Miss. The model, built to a horizontal scale of 1:1000, and a vertical scale of 1:100, duplicated the tides, salinity conditions, water intake, water heating by the refinery, and water discharge.

Results . . . Two flow arrangements were tested. One had the inlet channel located adjacent to the outlet channel. Here, the temperature rise at the inlet was about 1°. The other arrangement separated the two channels by 3,000 ft. This arrangement decreased the temperature rise to 0.7°. As constructed, the two channels are 5,600 ft. apart, and no appreciable temperature rise has been experienced.

4. Soils Exploration

Two steps . . . An extensive investigation of soil conditions affecting design and construction was made in two steps. Step 1 was a general investigation made while various arrangements of the refinery were yet under study. Step 2 consisted of extensive explorations made to develop specific recommendations for design and construction of the various parts of the refinery. Altogether 300 borings were made, along with many soundings of the Delaware River.

Marshland . . . Two of the three guard basins, all of the open channels, the gate structure, and some flumes are located in the marshland which extends 4,000 to 8,000 ft. inland from the shore line. This marshland is low, swampy ground containing many natural drainage channels. Surface soils are soft and compressible and contain extensive deposits of peat. These soft soils are as much as 60 ft. deep, and are underlain by moderately firm to firm cohesive soil. Soil tests of the marshland included shear, triaxial compression, unconfined compression, consolidation, chemical, and ignition.

Application . . . Results of these borings and core tests were especially useful in picking a location for the pumping station outside the marshland, and in calculating the stability of channel side slopes. In addition, they led to the decision to pile those structures which could not stand the large settlements expected in the marshland. These tests likewise established the permissible pile bearing capacities.

SPECIAL SECTION

5. Pumping Station Studies

Alternative designs . . . Early in the work, engineers compared preliminary designs and costs for two types of pumping station. One design had horizontal pumps located indoors, with the pump-room floor about 25 ft. below ground level to provide adequate positive head on the pump inlet. The other design had submerged vertical pumps with the motors outdoors. A design based on pumps with suction lift was not considered suitable, in view of the importance of reliability for this particular service.

Type of pump . . . A study showed that the first cost of horizontal pumps was less than that of vertical pumps. But this saving was more than offset by the increased cost of housing the horizontal pumps and of providing the deep intake wells. Thus the vertical-pump design was chosen.

Location . . . Cost studies were made of several alternative locations for the pumping station. A shore-line location lengthened the discharge lines, added to the pumping head, introduced construction costs associated with a deep-water installation, required pile foundations. Locations in the marshland offered but few advantages over a shore-line location.

An inland location beyond the edge of the marshland shortened the discharge lines, decreased the pumping head, simplified the disposal of water during construction, and did not require pile foundations. These advantages more than offset the cost of dredging the inlet channel needed to reach the station, and dictated the inland location of the station.

6. Hydraulic Tests

Model . . . The final design of the station provided for 12 pump chambers, although only 9 pumps are needed initially. What effect would this have on flow conditions? To help answer this question, the pump manufacturer made hydraulic model tests of the pumping station. The model-prototype scale ratio used was 1:10. Velocity similitude was established by use of Froude's law, and the pumps were selected to give correct velocities in the model.

Variables . . . The 12 tests made, covered a wide range of operating condi-

tions and various combinations of pumps. The tests also checked on several types of dividing walls to separate the pump chambers, on certain inlet gates closed to simulate conditions during periods of repair and maintenance, and on various submergence of the pumps.

Results . . . In general, the tests showed satisfactory flow conditions when operating 8 pumps in 12 chambers. None of the flows caused troublesome vortexing. The spacing of the pumps and the distance from the screens to the pumps proved adequate for straightening out the flow. These tests fully confirmed the preliminary design of pumping station.

7. Water-Hammer Tests

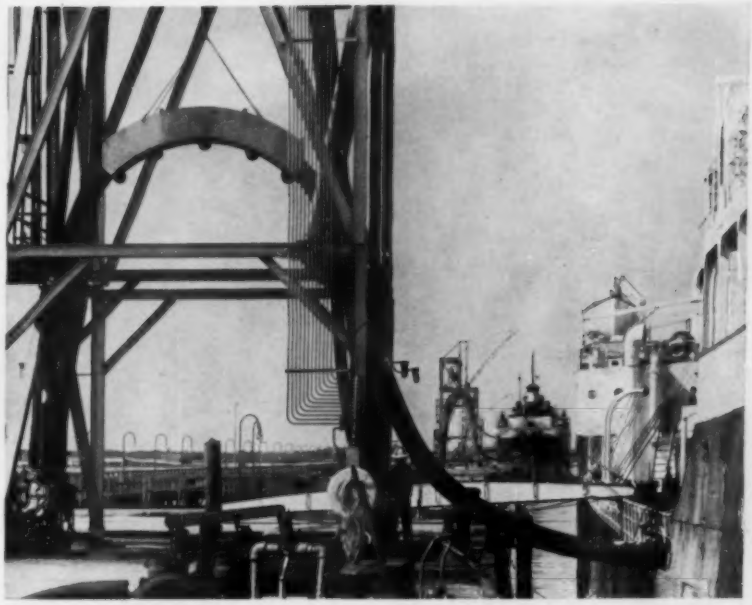
Field testing . . . During startup of the cooling-water system, field tests measured the effectiveness of the water-hammer control devices. On one of the headers, one, two, three, and four pump motors were tripped off several times simulating power failure. On the other header, one, two, and three pump motors were tripped off several times. Oscillographs recorded the pressure changes in the header at a point near the pumps, and the change of water level in the surge tank.

Design checked . . . These oscillograph records along with field observations indicated that the one-way surge tanks, the check valves at the surge tanks, and the butterfly valves on the pump-discharge lines, all operated in a very satisfactory manner. Pressures and water levels agreed very closely with the design computations. No resurges occurred.

Construction work on the cooling system started in June 1955 with the excavation of the trenches for the return lines. By July 1956, just 12 months later, the system was complete. Circulation of cooling water began in June 1956 with about 35,000 g.p.m. supplying the startup needs of the power plant. By the end of the year, the principal refining units were on stream and circulation of cooling water rapidly approached the design figure of 275,000 g.p.m.

C. F. Braun & Co. engineered the system, working in close cooperation with Tidewater's engineers. Braun also handled the design, procurement, and construction.

SPECIAL SECTION



HOSE-HANDLING FACILITIES include steel tower and support crane. Hoses range up to 10 in. in diameter.

THE Marine Terminal

. . . River barges to 68,000-ton supertankers

BY D. J. DOBBS AND J. M. PHELPS

CRUDE oil for the Tidewater Delaware refinery, and a major part of the refinery's products, pass through the marine terminal. The equipment at the terminal's three large T-headed piers can serve vessels ranging from river barges up to 68,000-ton supertankers of the Tidewater's rapidly growing ocean-going fleet.

Located on the west bank of the Delaware River, just north of Delaware City, the terminal is about 2 miles due east of the refinery process area. Its location was determined by the shape of the refinery property, proximity to the tankage area for shortest possible pipeline length, and proximity to the main river channel for least possible dredging.

Tanker approach . . . Tankers approach the terminal through a deep-water channel that leaves the New Castle Range of the Delaware River at its juncture with the Chesapeake and Delaware Canal. Range lights and flashing side lights mark the 400-ft.-wide approach channel. At the terminal the ships maneuver in a turning basin 1,500 ft. wide and ¾ mile long.

Mooring dolphins with electric capstans between the piers take the ship's bow and stern lines, and breasting dolphins at the end of each pier take the spring lines. All are interconnected by trestle catwalks, and floodlighted for night operations.

Piers 1 and 2 will berth tankers up to 68,000 tons. Pier 3 serves tankers of class T-2 and smaller. Pier 1 is for unloading crude only. Pier 2 unloads crude and loads nine products. Pier 3 loads nine products. All can furnish the ships with water, fuel, and other supplies. These steel-and-concrete oil piers represent the latest advances in marine loading technology.

Hose handling . . . As a part of the engineering study for the water-terminal design, the good and bad fea-

Authors are senior engineers, C. F. Braun & Co.

THE 45,000-TON WAFRA, one of Tidewater's own tankers, approaches the dock.

tures of 10 modern refinery docks were analyzed. One important result of the study was the development of a new type of hose-handling structure that requires but one man to handle the heavy loading hoses.

Each pier supports one of these structures, a 68-ft.-high steel hoist tower topped by a 2-ton, 40-ft. boom operated by three 3,500-lb. air winches. Up to 11 hoses are racked in each tower, each 75-ft. hose on an individual cradle with curved rollers that allow the hose to extend and retract smoothly. The boom handles a load line that positions the end of the hose at the ship's nozzle. A push-button station on each pier controls the hose winches and loading pumps.

Complete facilities at the terminal dispose of oily-water ballast and oil spills. All such oil is separated and returned to the refinery slops system. Electric pumps in a nearby fire-water pumphouse can protect the terminal area with 1,500 g.p.m. of 150-psig. firewater from an inlet of the river. A gasoline-motor-driven pump stands by, and an air-foam system and individual extinguishers round out the fire protection.

A dock-hand shelter on each pier houses telephone and intercommunication equipment. A 26 by 42-ft. concrete block building near Pier 2 houses the pier foreman's office, toilets, and locker facilities. A larger building adjacent to the water terminal furnishes offices for the marine superintendent, his staff, and port and customs officials.

Pier design . . . The piers are double-decked structures, reinforced-concrete slabs supported on H-section steel piles. The lower deck carries pipeways and the upper deck is a roadway for 10-ton trucks. The pier-head line is some 285 ft. from shore. The pier-head decks were poured in place, while the slabs for the connecting-stem trestle were pre-cast ashore.

The steel piles support their loads on a firm sand strata. They are encased in concrete at the water line for protection against erosion and corrosion. A small copper plate, wired to each pile head, was cast into each concrete pile cap as a provision for future cathodic protection if it becomes necessary.

The pipeway between the terminal and the refinery tankage area is supported on concrete sleepers. It holds 25 miles of pipe, in sizes from 4-in. diameter up to a 30-in. crude line which will deliver 25,000 bbl. per hour. These lines must operate at an average of more than 5 hours per day to keep the refinery on stream.

C. F. Braun & Co. provided the water terminal facilities as part of the over-all refinery engineering and construction contract. Frederick Snare Corp. was subcontractor for pier construction. American Dredging Co. dredged the basin, the channels, and the inlets for the refinery cooling-water system, all of which required a total of 14,000,000 cu. yd. of underwater excavation.

THE Maintenance Program

This is largely contracted; cost easily figured

BY contracting for the major portion of maintenance at its new Delaware refinery, Tidewater Oil Co. will have a maintenance cost-control and accounting system as modern as the new 130,000-bbl. refinery itself. The maintenance contract was let to Catalytic Construction Co., of Philadelphia.

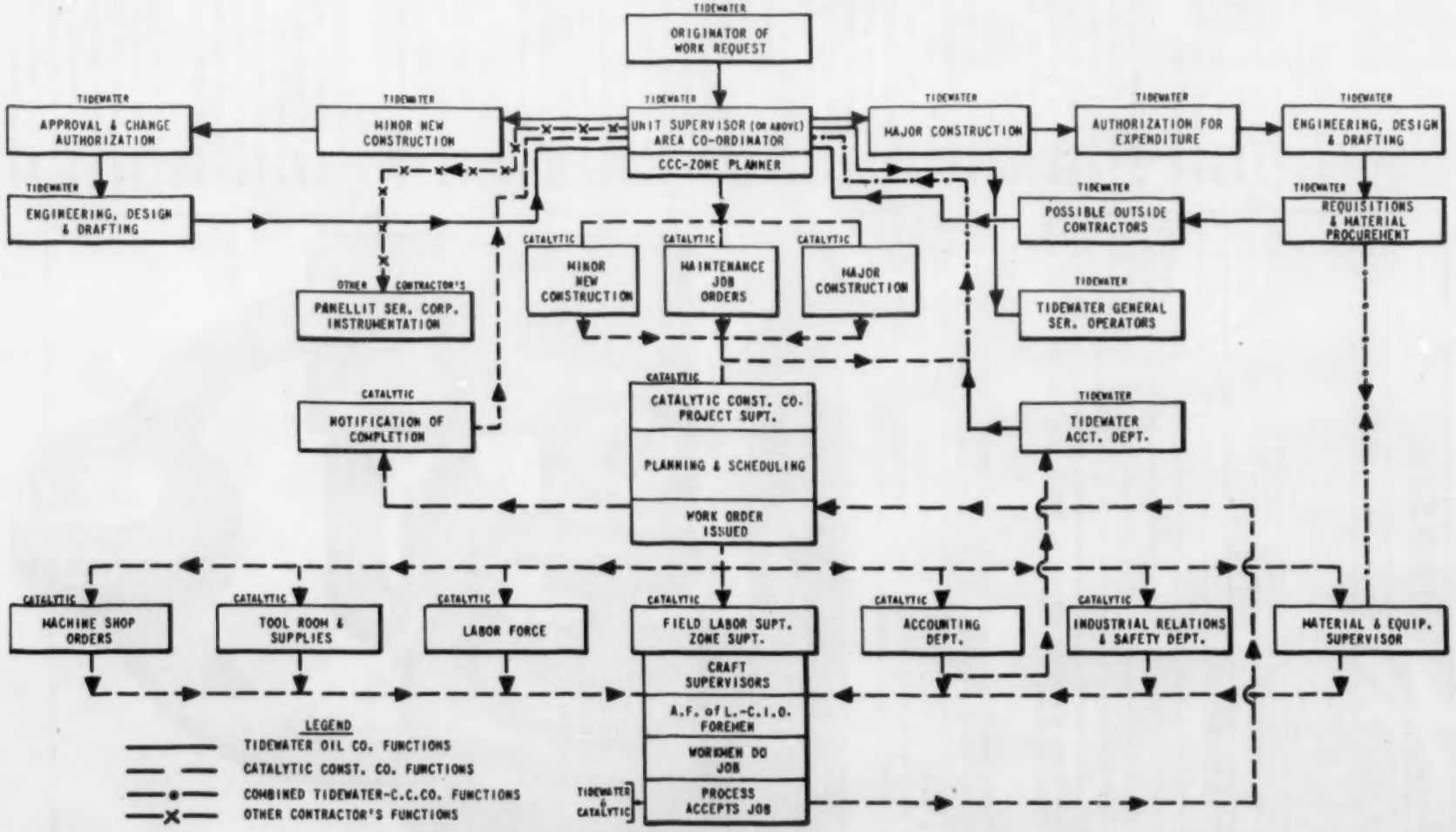
Maintenance is an important cost factor in refinery operation. Full performance of the refinery can be measured accurately only if true and accurate maintenance cost figures are available and if there is effective control of maintenance costs. The procedures and arrangements worked out between Tidewater and Catalytic provide accurate cost data and effective cost control. Tidewater can figure its maintenance labor costs every week from the contractor's pay roll.

SPECIAL SECTION

Combination operation . . . Maintenance at refinery is a combination of area and centralized operations directed by Robert R. Beattie, Tidewater's superintendent of engineering, maintenance, and construction. His organization includes a small, highly qualified engineering group and five area coordinators who assign the work and who coordinate all maintenance activities. This group works with E. J. Hammond, Catalytic's project superintendent.

"The contract maintenance program of Tidewater," said Beattie, "is

TIDEWATER FLOW CHART
Work Requests and Work Orders



TIDEWATER OIL CO.
DELAWARE "FLYING A" REFINERY

DAILY WORK SCHEDULE

AREA _____
DATE _____

WORK ORDER	ANNUAL ORDER	PRIOR	SEQ.	WORK DESCRIPTION	CRAFT	MEN	AVAILABLE M.H. 1 2 3 4 5 6 7 8	AVAILABLE M.H. 1 2 3 4 5 6 7 8
				TOTAL MEN IN AREA				

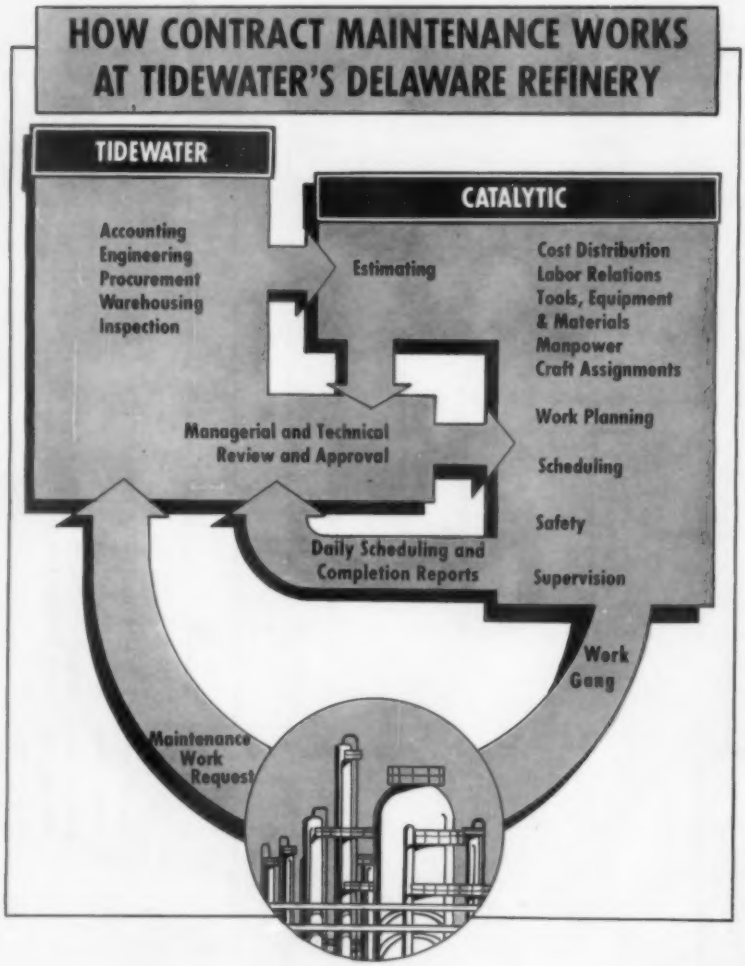
RECAP OF PREVIOUS DAYS WORK

BACK LOG WORK
LAST MONTHS
EXISTING MH
TODAY'S MH
TOTAL

DAILY WORK SCHEDULE sheet for the refinery. Note that only top and bottom of the sheet are shown.

in keeping with the progressive philosophy which led to the building of this modern, high-efficiency plant. The program has been worked out to meet the exact requirements of the Delaware refinery, which incorporates features never before built into a petroleum processing plant."

The procedures worked out for maintenance operations are simple. Maintenance work requests originate at the operating units and go direct to the Tidewater area coordinator, who may approve and forward to Catalytic, or who may check on the needs, get an engineering or management review, or ask Catalytic for detailed cost estimate if the request is for a job for which costs are not already established.



Estimate form . . . The form which Catalytic uses for these estimates is the regular maintenance work order form, which when approved gives in addition to detailed cost data all the necessary authority and instructions for the work. These work orders are summarized on a daily work schedule which at a glance tells all concerned Tidewater personnel exactly what work is under way at any time throughout the plant.

Advantages claimed for the contract maintenance plan include an adequate supply of competent workmen to meet a recognized fluctuating requirement by utilizing qualified craftsmen of the A. F. of L. building trades unions. Maintenance workers are only on the job when required. "Made work" is eliminated.

The maintenance contractor, Catalytic, has responsibility for planning, coordination, and supervision of work in the field. Tidewater requires only enough maintenance staff to assure effective coordination of the requirements of management and operating staff with those of the contractor, and to provide continuity of experience with equipment and the over-all process system.

Beattie's staff is thus tailored to meet the requirements of the refinery management with respect to supervision, control, and inspection of maintenance services and performance, with the primary responsibility on the contractor.

Catalytic maintenance forces provide maintenance engineering, planning and scheduling service. The determination of tools, materials, and manpower requirements are made by the contractor, who is also responsible for craft assignments, labor relations and safety in the maintenance field.

The Catalytic procedure for detailed job analysis to obtain precise cost estimates and allocations enables the Tidewater refinery management to project maintenance costs and to plan to meet in an orderly fashion the peaks and valleys of maintenance manpower needs.

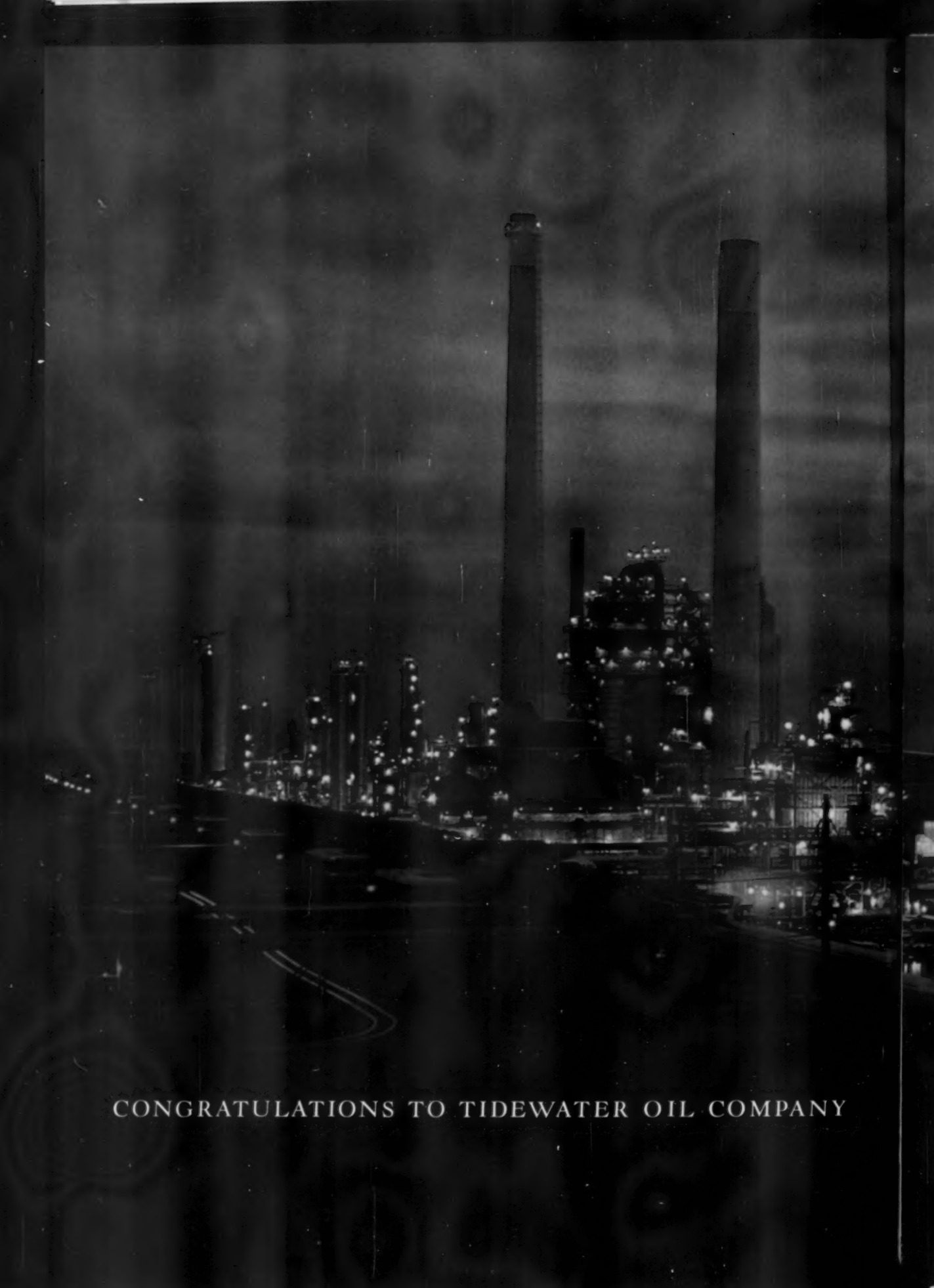
THANK YOU!

The Tidewater Delaware Refinery was built through the hard work and cooperation of many people. To all of them we extend our thanks and appreciation. To the management and engineers of the Tidewater Oil Company. To the engineers, construction-staff, and workers of our own Company. To the licensors, the sub-contractors, the many suppliers. And to the officials and members of the A F of L Building and Construction Trades Unions. All may take pride in this accomplishment.

C F BRAUN & CO

ENGINEERS AND CONSTRUCTORS

ALHAMBRA, CALIFORNIA


CONGRATULATIONS TO TIDEWATER OIL COMPANY

ON THEIR DELAWARE REFINERY

Engineered and constructed by C F BRAUN & CO

Braun Engineering Headquarters at Alhambra, California

ECONOMIC STUDIES · CONSULTING ENGINEERING · APPLIED RESEARCH

ENGINEERING · DESIGN · FABRICATION · CONSTRUCTION

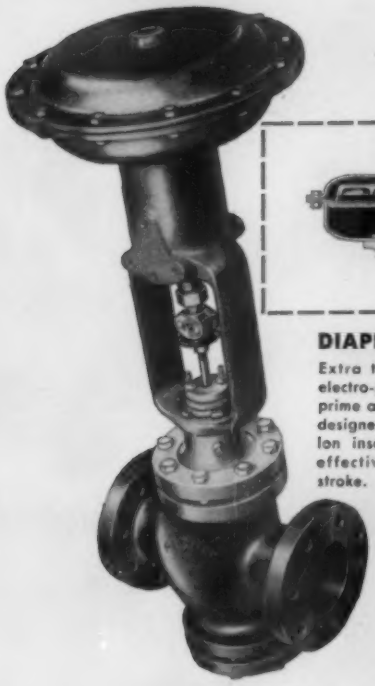
C F BRAUN & CO

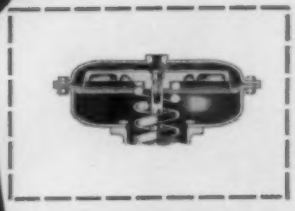
ALHAMBRA CALIFORNIA

Any Way You Look At It

FISHER® Control Valves

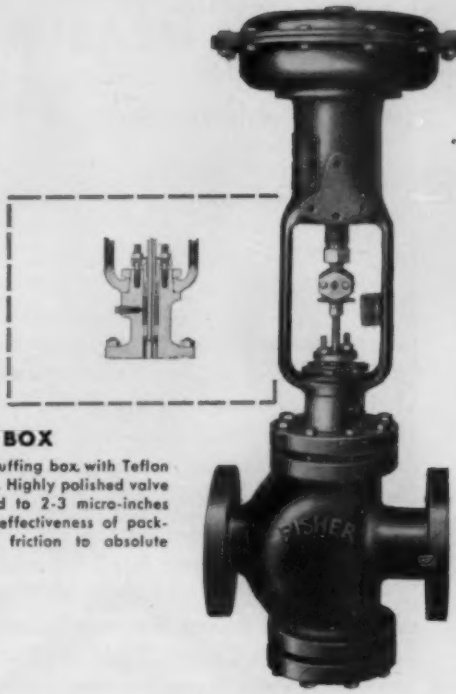
are your BEST BET!





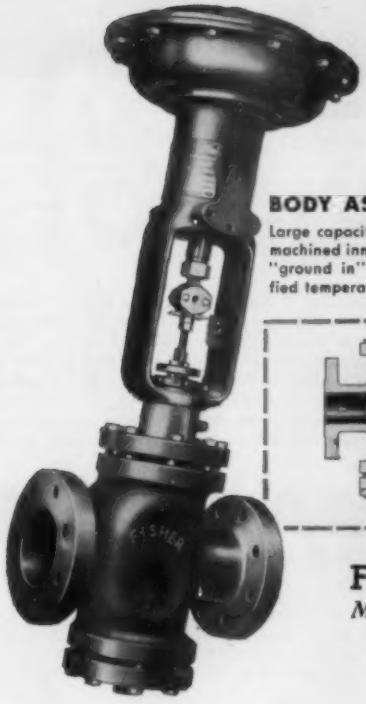
DIAPHRAGM ASSEMBLIES

Extra thick steel casings are zinc electro-plated, iridited and then given prime and final paint coats. Specially designed molded diaphragm with nylon insert gives practically constant effective area throughout valve stroke.



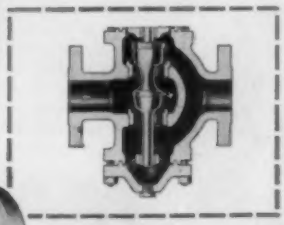
STUFFING BOX

Bolted gland stuffing box with Teflon V-Ring packing. Highly polished valve stem is finished to 2-3 micro-inches RMS to insure effectiveness of packing and keep friction to absolute minimum.



BODY ASSEMBLIES

Large capacity bodies with accurately machined inner valves are individually "ground in" under customer's specified temperature conditions.



Fisher is proud to have been selected by Tidewater Oil Co. to supply the control valves and liquid level controllers for this wonderful New Delaware City Refinery.

FISHER GOVERNOR COMPANY

Marshalltown, Iowa • *Woodstock, Ontario*

World Leader in Research for Better Pressure and Liquid Level Control

GIANT TIDEWATER REFINERY HAS ALL THREE

PROTECTION

CONTROL

MEASUREMENT

with reliable products of Manning, Maxwell & Moore

The Tidewater Oil Company's mammoth new Delaware Refinery is rightly referred to as the "refinery of the future." C. F. Braun & Co., engineering contractors, built the plant on the 5,000 acre site. Most of the processing units are unequalled anywhere for size and capacity. Tidewater incorporated the most advanced design and equipment to assure the greatest flexibility, economy and safety.

To provide around-the-clock protection, control and measurement, this ultra-modern refinery makes full use of dependable Consolidated Safety Relief Valves, Hancock Valves and Ashcroft Pressure Gauges. These products of Manning, Maxwell & Moore are precision engineered and built to insure the perfect performance, freedom from costly maintenance and long-life service so vital to economical refinery operations.

Whether you are modernizing or enlarging your plant for increased capacity . . . whether you are scheduling a "turn-around," planning a new processing unit or adding storage facilities – call on Manning, Maxwell & Moore regarding problems in protection, control and measurement. District offices and industrial distributors in the United States and Canada as well as agents and manufacturing licensees throughout the world are ready to serve you.

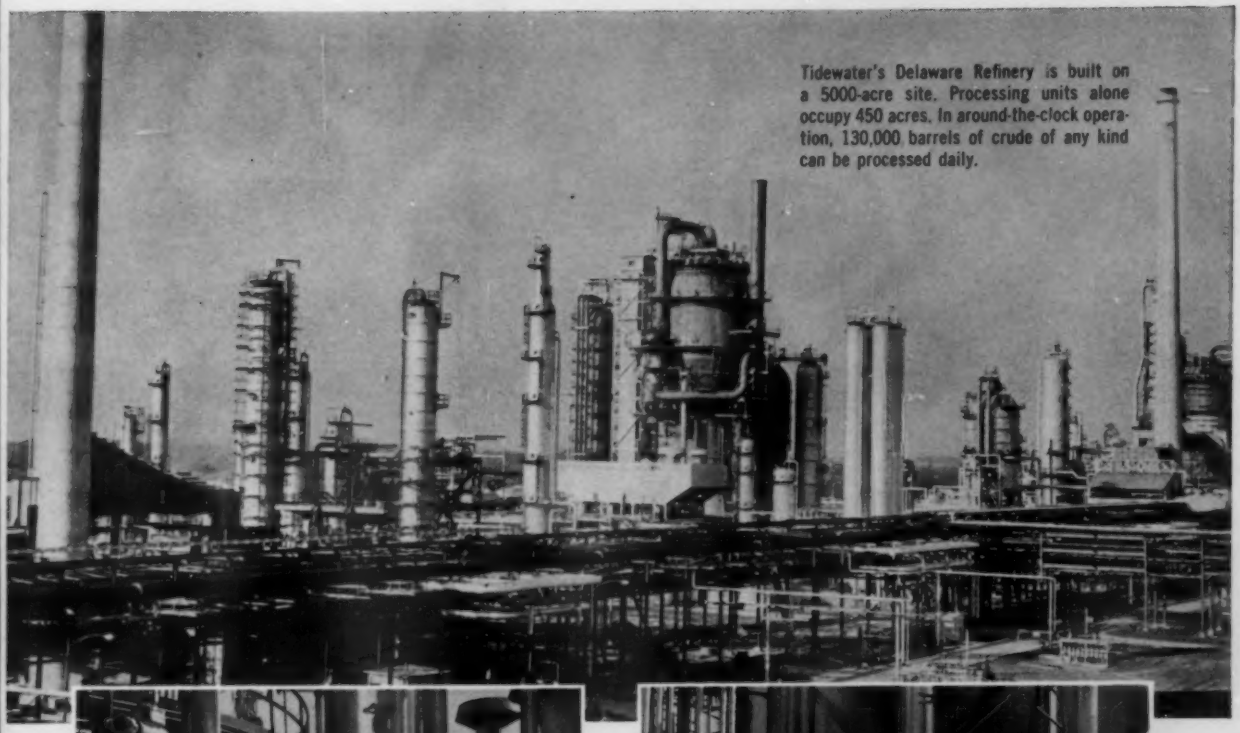
PROTECTION

. . . by CONSOLIDATED SAFETY RELIEF VALVES. The Orthoflow fluid catalytic cracker at Tidewater's Delaware Refinery is the world's largest. It is equipped with Consolidated Safety Relief Valves as are the propane storage bullets. These valves assure absolute protection through peak performance and consistently positive action, even where "superimposed" back pressure is in the relieving system.

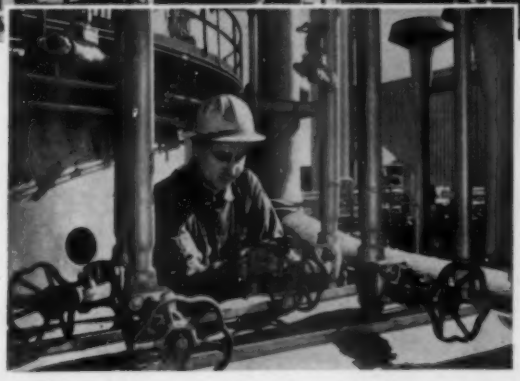
Consolidated Safety Relief Valves are "2 in 1" valves with interchangeability so highly perfected that the Standard valve can be converted to the Balanced Bellows Seal type *in the field.* Standardized inlet and outlet face-to-face dimensions permit these valves to be interchanged with those of some other manufacturers.

Fewer functional parts and precision machining and alignment of parts assure long valve life and less maintenance.

MANNING,



Tidewater's Delaware Refinery is built on a 5000-acre site. Processing units alone occupy 450 acres. In around-the-clock operation, 130,000 barrels of crude of any kind can be processed daily.



CONTROL

. . . by **HANCOCK VALVES.** The fluid-handling systems in Tidewater's Delaware Refinery must be kept at highest operating efficiency. To help control flow in the vast network of "fluid highways," hundreds of Hancock Valves are installed.

These manually-controlled valves are designed and built to give reliable performance under the pressures, temperatures and piping strains common to the most modern processing plant. All materials used in their construction are carefully selected — rugged strength and durability are engineered into every component. The super-hard seating surfaces are highly resistant to galling, steam cutting, wire drawing, erosion and corrosion. Positive tightness — leak-proof tightness — is assured month after month. Maintenance requirements are reduced to a minimum. Long-life service proves that there is no substitute for the economy of quality found in all Hancock Valves.

MEASUREMENT

. . . by **ASHCROFT PRESSURE GAUGES.** Accurate pressure measurement is essential to maintain product quality . . . to assure capacity performance of equipment and economical production in Tidewater's Delaware Refinery. Ashcroft Duragauges are precision instruments. They employ rotary geared motion — the most efficient and perfect method of transmitting mechanical motion. A choice of stainless steel movement or stainless steel with nylon bearings and pinion gear permits selection to meet specific requirements. Eight different Bourdon tube materials are available. Each Bourdon tube is "whip tested" at pulsating pressures approximately 50% higher than its pressure rating to insure calibration stability. Three case designs and materials and a complete range of dial sizes and pressures also provide for every individual need. Highest sustained accuracy and long service life are assured.

MAXWELL & MOORE, INC.

CONSOLIDATED ASHCROFT HANCOCK DIVISION

STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.*, 'HANCOCK' VALVES, *Watertown, Mass.*, 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.*, AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.* **In Canada:** Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.

MAXWELL MANNING MM&M MOORE INC. TRADE MARK

Double blocking with one valve and no blind

How Phillips Pipeline gets double valving control at single valve cost

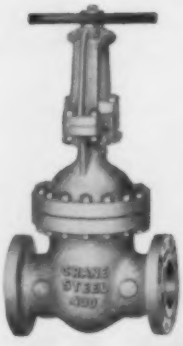
Phillips Pipeline Co. has this benefit at all 25 pump stations on its Texas-to-Illinois products line. The manifold at its Stinnett Station, shown above, is typical.

Here is the economical solution for holding two dissimilar products with a single valve, without any mixing. The valves are Crane 400-pound steel gates, modified with a flexible wedge disc, and equipped with a bleeder valve at bottom of the body.

When a cross-over line valve is closed, depending on product being pumped, pressure on upstream side of disc may be up to 500 psi. On the downstream side, it may reach 1100 psi. Yet with the bleeder valve open to atmosphere, there is *no leakage past the disc* and *no product contamination.*

Each of these Crane valves does the work of the usual two. Installation costs are halved. Station personnel work better and faster with half as many valves to operate.

This Crane valve principle is ideal for pipeline, dehydrator or refinery—wherever double blocking is practiced. Ask your Crane Representative for full information, or write to address below.



CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

42,000 B/D UNIT AT TIDEWATER OIL COMPANY'S NEW DELAWARE REFINERY

AT TIDEWATER'S NEW REFINERY—A GIANT FLUID COKER HELPS MAKE MORE VALUABLE PRODUCTS

An outstanding feature of the new Delaware Refinery of Tidewater Oil Company is this *Fluid Coking* unit that will feed 42,000 barrels per stream day. This unit and its twin at Avon, California, are the world's largest. Licensed by Esso Research and Engineering Company, *Fluid Coking* is the first successful fully continuous process for converting low value pitch into valuable lighter products.

At installations like Tidewater's new plant, *Fluid Coking* handles the heaviest feed that can be pumped. It results in a higher percentage of gas oils and makes possible greater ultimate yields of good quality heating oil and gasoline. Yet investment and operating costs are lower. The coke produced will be used as fuel for steam and power generation in the Delaware Power and Light Company's installation at the new Delaware Refinery.

The process is another achievement of the Esso Research program — 38 years of new process developments made available to refiners around the world.

Tidewater Oil Company, like other licensees, will also enjoy the benefits of continuing *Fluid Coking* research. *Fluid Coking* can play an important part in helping to process formerly uneconomical crudes and maintain refinery balance.

ESSO RESEARCH AND ENGINEERING COMPANY

15 West 51st Street, New York 19, N. Y.

Your key to progress... an Esso Research process

Each a towering problem solved with

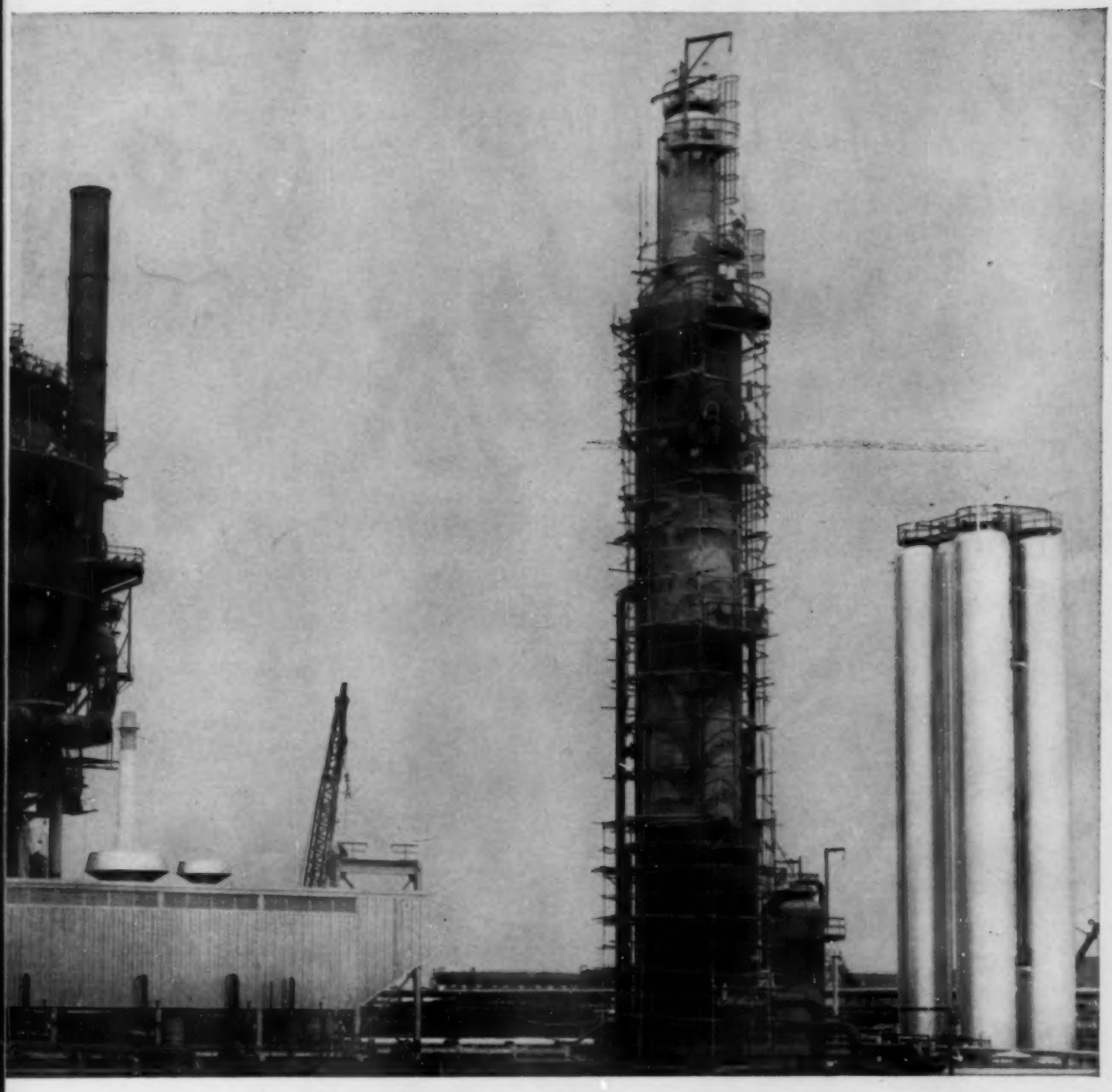
NEW TIDEWATER DELAWARE FLYING A REFINERY TAKES 12 TYPES—1,800 TONS

Choosing from the widest range of such materials available from any source, designers and fabricators for Tidewater carefully selected Lukens clad and alloy steels for the heart of its new Delaware Flying A Refinery.

To resist the corrosive attack of sulfur compounds and naphthenic acid—Lukens stainless clad types 316-L, 405 and 410; for chlorides—Lukens Monel-clad; for high-temperature service—Lukens A-204 alloy; to resist hydrogen attack and graphitization and for strength at high temperatures—Lukens A-301 alloy.

And for economical protection against a variety of other corrosive and abrasive problems Tidewater chose 6 additional types of Lukens clad steels—Inconel, nickel and copper; 304, 304-L and 316 stainless.

Lukens clad steels offer all the protection of solid high alloy—economically. The bond is permanent; you can use the combined gage of cladding and backing metals in designing to meet Code requirements. Flanges and pipes can be welded on, even after vessel installation.



Lukens clad and alloy steels

Consult your equipment builders, or write for the new **Clad Steel Equipment** bulletin and information on alloy steels. Manager, Marketing Service, Room 983, Lukens Steel Company, Coatesville, Pa.

This is Lukens clad steel, a proven product. Not a lining, not a soldered-on surface, but a solid steel plate—one side corrosion-resistant high alloy, the other economical alloy or carbon steel permanently bonded on powerful rolling mills.

LUKENS

Helping industry choose steels that fit the job

Congratulations...

TIDEWATER OIL COMPANY

To those men of vision in the Tidewater Oil Company, whom it has been our pleasure to serve with MEX-R-CO "Better Refractories," our sincere congratulations on the construction of the record-breaking and high-performance production facilities at the Delaware City refinery . . . to meet the growing needs for high quality products.

Their foresight is evidence of the progressiveness of their management and of the encouraging evidence the company has in the future of our nation. We are indeed proud to cooperate with such a distinguished organization in improving production to better serve industry.

PLACE YOUR REFRACTORIES NEEDS IN THE SURE HANDS OF EXPERIENCE

MEX-R-CO

MEXICO REFRACTORIES COMPANY

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Canadian Affiliate: REFRACTORIES ENGINEERING & SUPPLIES, LTD.—Hamilton, Ontario, Canada

Refractory Castables — Insulating Castables — Firebrick — Mortars for Catalytic Cracking and Reforming Units, Lines, Ducts, Towers, Stills and Boilers

Here the Brent Company's HD-16 torque converter tractor moves mud out of a sump. Says operator Joe Myers, "I say this A-C crawler tractor can't be beat. The '16 will take right off in third gear. On this work, a tractor needs constant power and speed to stop the mud from draining back into the sump. The '16's got both."

"BEATS 'EM ALL IN SOFT MUD,"

—says oil field superintendent

D. T. Phillips, superintendent for Brent Construction Co., Ltd., Estewan, Saskatchewan, states:

"For working in drilling mud on sump jobs, we find the Allis-Chalmers HD-16 can operate in a lot softer mud than any other crawler tractor.

"First we bought an Allis-Chalmers HD-15 and on the basis of this machine's fine performance, we got a '16. We find it's an excellent crawler for sump work, winch work and for moving mud.

"After drilling operations, the HD-16 moves into the sump and spreads the mud out evenly to dry, then fills the hole with dry earth. On an average sump 5 ft. x 75 ft., we can slope the mud, fill the hole and renovate a four-acre section in about seven hours with our HD-16."

Find out how Allis-Chalmers crawler tractors can speed your oil field jobs. Your nearby dealer can tell you how Allis-Chalmers exclusive advantages mean better performance. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

new small instruments in fiber glass cases
indicate . . . transmit . . . control temperature or pressure

NOW . . . instruments as corrosion-resistant as the equipment they control! Every instrument in Fischer & Porter's new 1450 Series is housed in a fiber glass reinforced polyester case resistant to acids, alkalis, salts, solvents, dust, and weather. You can place indicators, transmitters, and controllers wherever you want—inside or out—without regard for corrosive fume and splash. The protection is built right into the housing . . . nothing to wear away or scratch off . . . no coatings to renew. The first such equipment available for process instrumentation, Series 1450 brings a new flexibility and freedom to instrument installation.

There's no way for corrosive atmospheres to reach the working instrument. Every exposed part is either plastic or 316 stainless steel. And a polyvinyl chloride gasket provides a positive seal against dust and moisture entry.

F&P has engineered the unique new 1450 Series housing for operation and maintenance ease. The entire instrument can be removed from the case if desired. Zero adjustment and range changes are easy. A plug in the removable door provides access to the adjustment screw for the optional external set point.

Field tested over a one year period, the 1450 Series is available NOW on four week delivery schedules.

SERIES 1450

CORROSION-PROOF INSTRUMENTS

Temperature Range:

minus 400F to plus 1000F.

Pressure Range:

30" Hg vacuum to 5000 psi
As pneumatic receivers, 1450 instruments accommodate 3 to 15, 3 to 18, or 3 to 27 psi signals.

Instrument Options:

Single indicator • dual indicators • single indicator with dual alarms • indicating controller with any mode of control • indicating transmitter. Transmitter can provide pneumatic outputs, resistance outputs, or differential transformer outputs.

Controller Options:

- universal controller with on-off, proportional, differential gap, and manual reset
- wide band proportional
- wide band proportional plus automatic reset
- wide band proportional plus automatic reset plus derivative

Mounting:

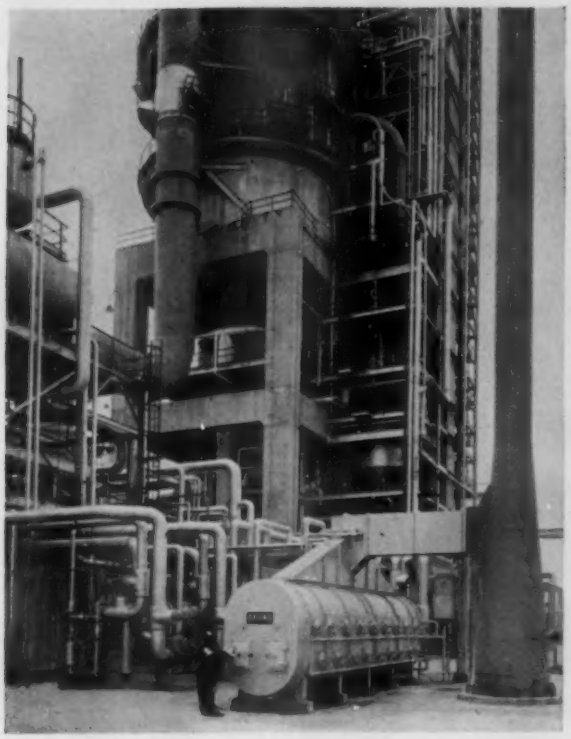
Suitable for surface, pipe, or panel mounting. Panel cutout size is 8¼" x 10¼".

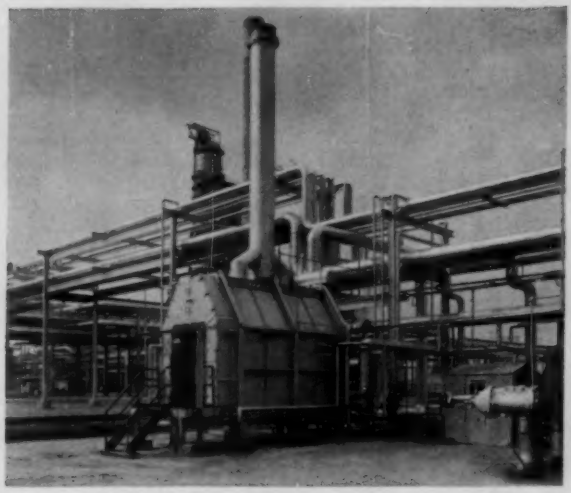
For complete data write Fischer & Porter Co., 3157 County Line Road, Hatboro, Penna.

FISCHER & PORTER CO.

Complete Process Instrumentation

GRADIATION® and ECONOTHERM*. . . Selas Heaters designed and built to meet your processing needs





The Gradiation barrel-type heater (left) superheats steam in two precisely-controlled stages of Tidewater's continuous coking process. The Econotherm heater (above), designed and built to serve low cost requirements where precision heating is not a consideration, maintains asphalt in fluid form for easier handling.

. . . perform critical and non-critical operations at Tidewater Oil Company's ultra-modern Delaware Refinery

Selas is proud to have a part in the development of Tidewater Oil Company's new Delaware plant, the largest refinery ever built at one time. Here, where initial capacity is 130,000 b/d:

- Gradiation heating meets critical processing requirements
- Econotherm heating serves non-critical demands

Each heater is designed and built to perform its specific function.

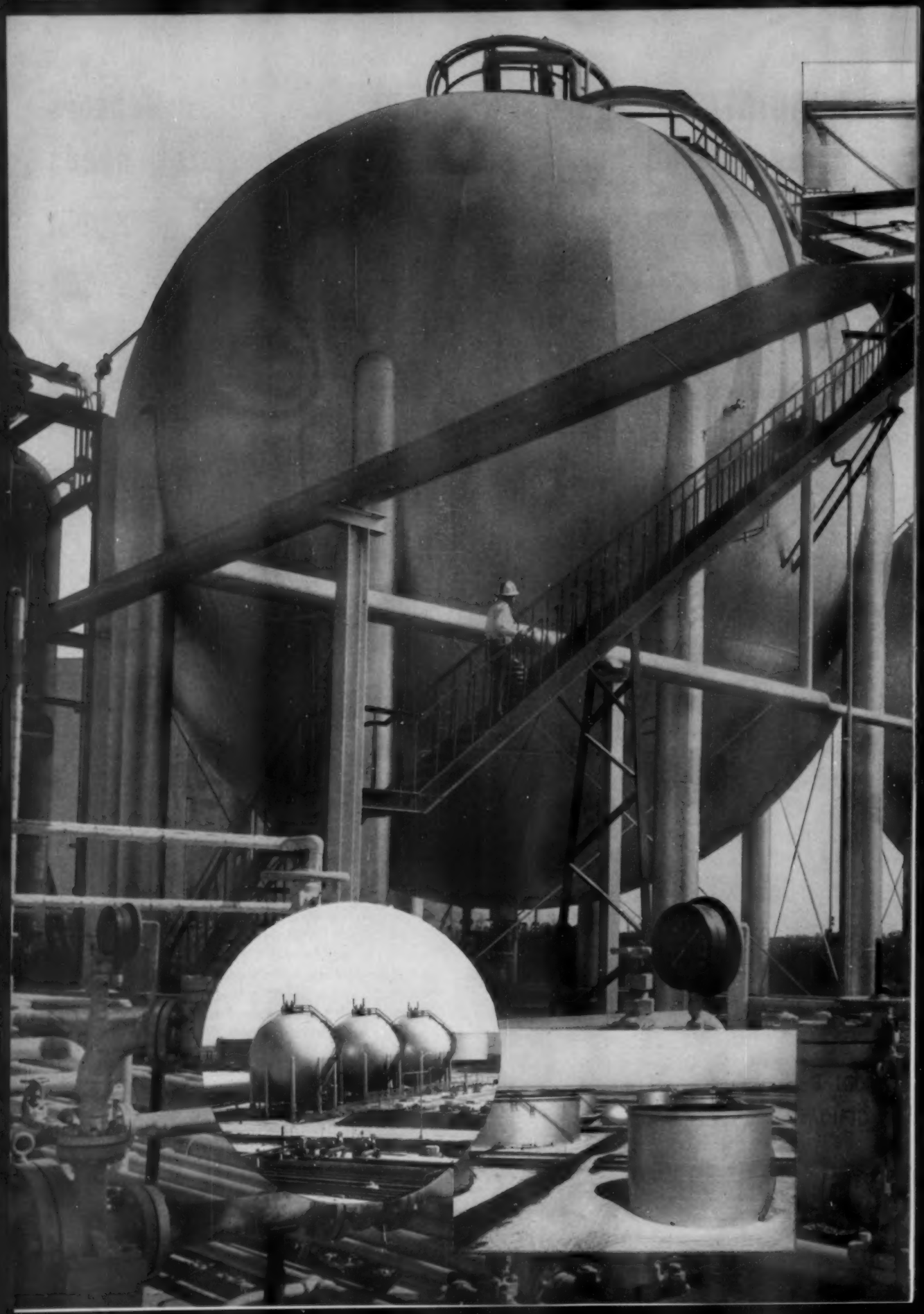
When the petroleum, petrochemical and chemical industries require preciseness in heating, ability to handle a variety of feed stocks, instant response to controller demand, Zone Control . . . they specify Gradiation. When heating is to be performed below the decomposition point of the material, when low first cost is the important factor . . . they choose Econotherm. Both are Selas heaters; both bring to each process Selas knowledge, skill, experience and service.

Write Dept. 235 for bulletin "Gradiation Heating for Petroleum and Chemical Processing."

* Trade Name

SELAS
CORPORATION OF AMERICA
DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers
DEVELOPMENT • DESIGN • CONSTRUCTION



CB&I-built tank farm stores all

7 MILLION BARRELS

...for Tidewater Oil Company's Delaware Refinery

Tidewater Oil Company's new ultra-modern 130,000 barrel per day "Refinery of the Future" is served by one of the largest tank farms ever built by Chicago Bridge & Iron Company.

All crude and petroleum products in the refinery will be stored in the 7-million-barrel tank farm fabricated and erected by CB&I, and furnished through the C. F. Braun Company. This includes: 50 Horton® Floating Roof tanks, 63 Horton Cone Roof tanks, 5 Hortonspheres® and 3 Hortonspheroids®. Also built for "Operation Tidewater" were Horton process structures including reactors, fractionators and drums.

The design, fabrication and erection of petroleum storage and processing equipment is a specialty—and an art, with Chicago Bridge & Iron Company. Write our nearest office for the new bulletin on CB&I *Field Services.*

P-55CB

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.
REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland
SUBSIDIARIES:
Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas;
Chicago Bridge Limited, London; Sociedade Chibridge de Construcoes Ltda., Rio de Janeiro.

THERMOMETRY

AT TIDEWATER'S NEW DELAWARE REFINERY

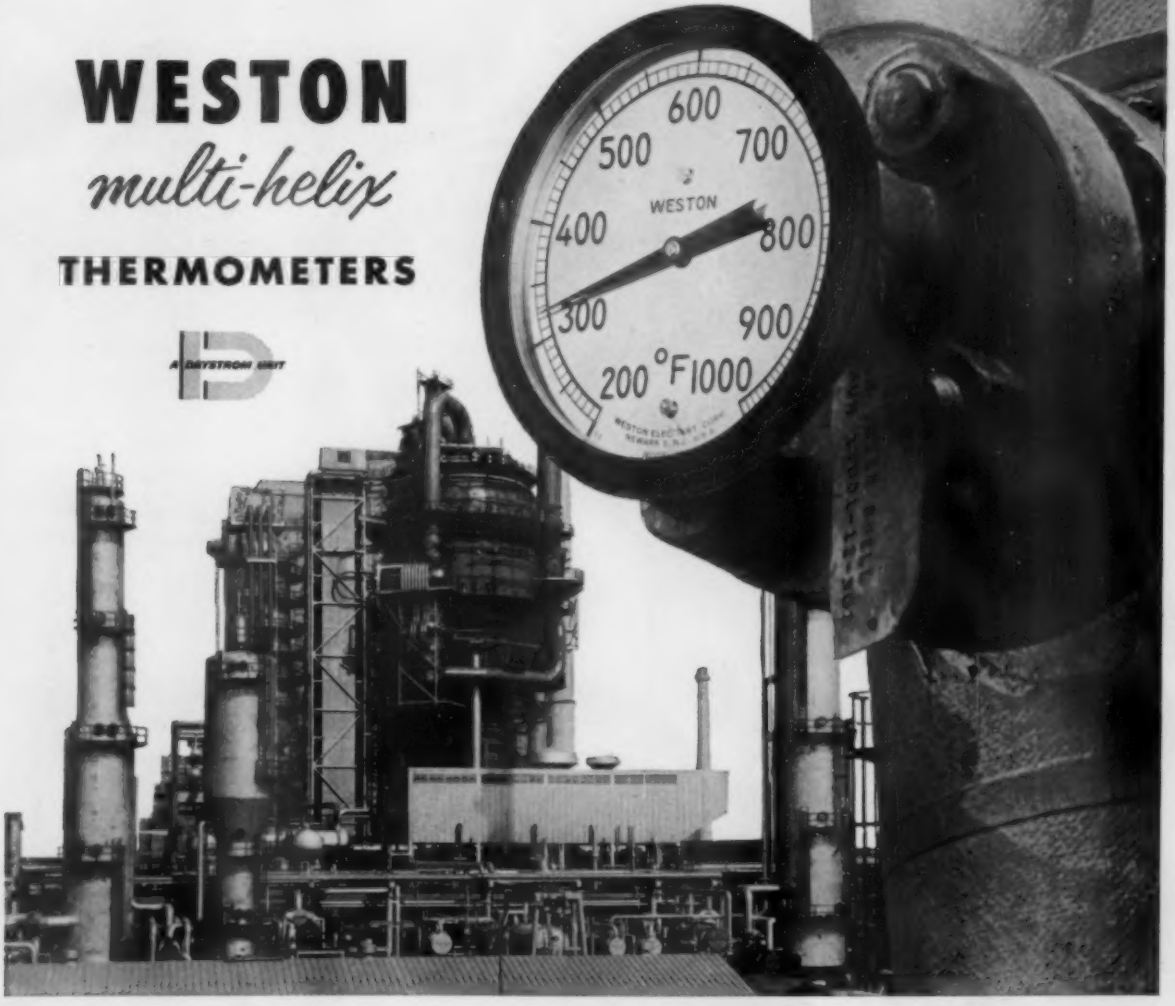
Large plant or small, thermometer specifications invariably are based on *past performance* . . . the ability of the thermometer to *stay* on the line – give years of accurate, trouble-free service –effect savings in overall costs. On this basis WESTON bi-metal thermometers invariably get the nod. For years their *exclusive* multi-helix sensing element has proved far superior in accuracy, repeatability, and stability. They provide *all* the dependability essential in modern processing. Available in types, sizes and ranges for most industrial needs. For all the facts write – Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 12, N. J.

WESTON

multi-helix

THERMOMETERS

A DAYSTROM UNIT



we are Proud...

that

YORKMESH DEMISTERS

(MIST ELIMINATORS, ENTRAINMENT SEPARATORS)

are on this Job...

When clean separation between vapor and liquid are important Yorkmesh Demisters are carefully engineered and manufactured to give the performance required.

Details on your operating conditions will enable York engineers to take full responsibility for furnishing the correct Demister. York has more than 10 years of specialized experience in problems such as improving product quality, increasing thruput capacity, reducing maintenance costs and eliminating entrainment losses—by clean separation of vapor from liquid entrainment.

Yorkmesh Demisters give excellent performance in:

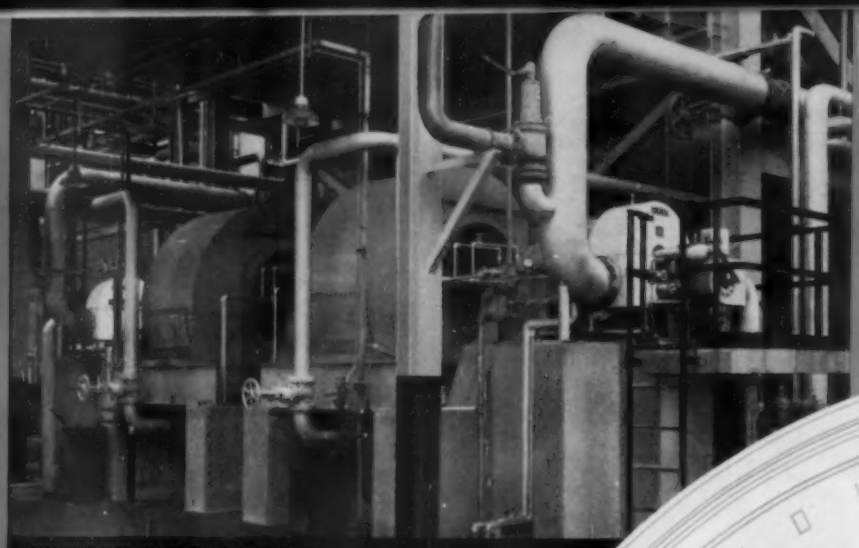
Vacuum Towers • Distillation Equipment • Knock-Out Drums • Steam Drums • Gas Absorbers • Scrubbers • Evaporators •

OTTO H. YORK CO., INC.

6 CENTRAL AVENUE • WEST ORANGE, NEW JERSEY

YORK

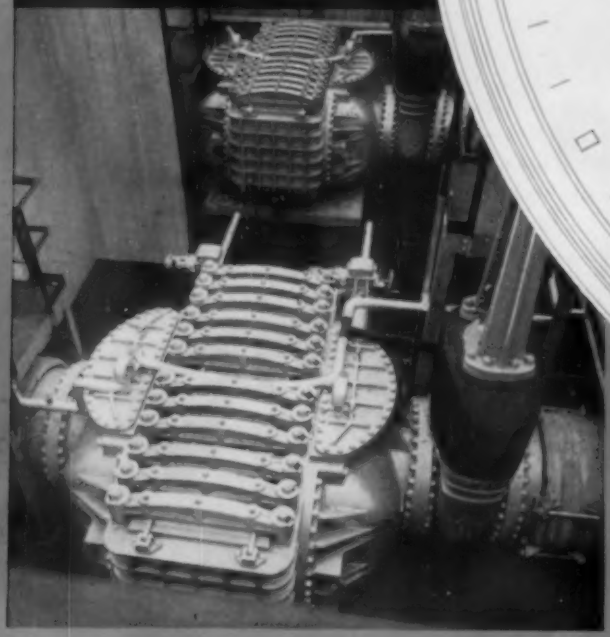
Specialists in FLUIDS SEPARATION / ENGINEERS and MANUFACTURERS



ELLIOTT TURBINES which drive forced draft fans in one of the many boiler plants of the Tidewater refinery.

ALL-THE TURBINES employed in Tidewater's Delaware refinery are Elliott. Here one of them drives an oil pump.

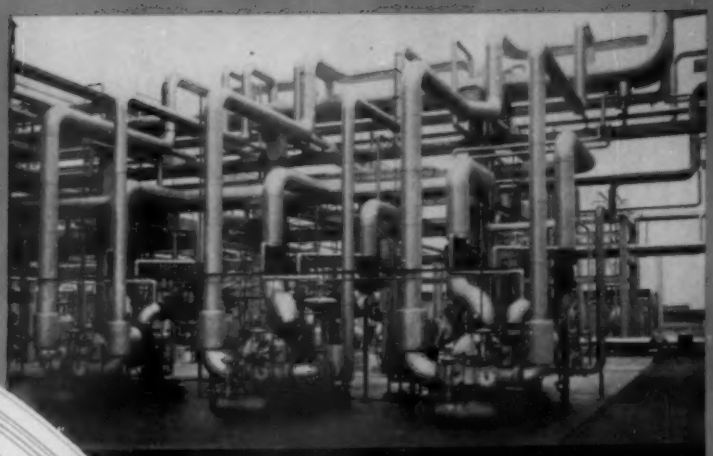
TWIN STRAINERS include these 36 in. Elliott twin strainers with motor-operated valves.



'round-the-clock dependability

ELLIOTT PRODUCTS

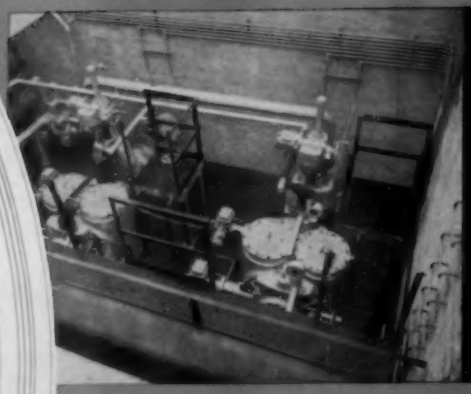
serve Tidewater's Delaware Refinery



STEAM TURBINES built by Elliott drive oil pumps throughout the Tidewater refinery. Three installations are seen above.

The 130,000-barrel-per-day Tidewater Oil Company refinery in Delaware is "on stream" 'round-the-clock and continuous and dependable performance of its equipment is vitally important. Elliott products are excellently suited for this type of operation because they are designed and built for long-term, non-stop, trouble-free service.

The steam turbines which drive the pumps and fans are all Elliott-engineered, ranging from 5 to 935 hp. All of the water serving this refinery is put through Elliott twin strainers located throughout the operation, in sizes 3 in. to 36 in. The Elliott 3-stage twin ejector unit is the largest of its type anywhere in the world.



TWIN STRAINERS also include these two 16 in. motor-driven Elliott twin strainers and a 6 in. hand-operated twin strainer.

ELLIOTT Company

JEANNETTE, PA.

TWIN EJECTORS seen here are 45 feet long, produce 60-in. suction and discharge to intercondensers. They are the first stage of twin 3-stage Elliott ejectors which maintain an absolute pressure of 5 mm..

O 7-8

100 pressure
90 temperature
400 flow
32 level

. . . measurements are taken at Tidewater by Taylor Transmitters

FOR what has been described as "the world's most modern refinery" near Delaware City, Tidewater Oil Company and their engineering constructors, C F Braun & Co., selected Taylor Transmitters for practically all temperature, pressure, flow, level and differential pressure measurement.

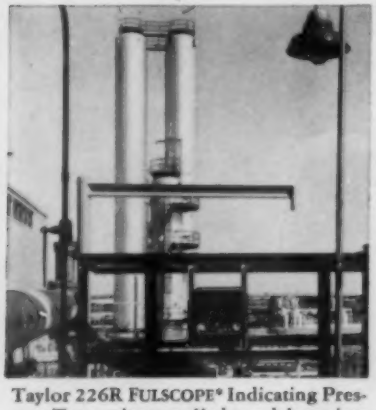
Measurement of these variables is critical from both an operations and economy standpoint, and we are proud of the fact that Tidewater considered the performance of Taylor Transmitters has justified their selection. Instruments required a minimum of adjustment in putting the refinery on stream. C F Braun & Co. engineers were impressed with the promptness of delivery of the original order as well as last minute requirements.

Reputation for Low Maintenance Big Factor

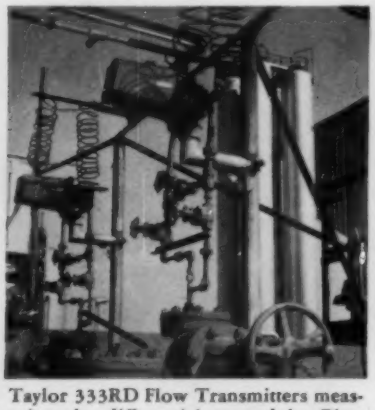
Taylor Transmitters have long enjoyed a reputation for low maintenance. A tour of other refineries where quantities of these instruments were being used, quickly confirmed the reports. Equally impressive are the design features permitting changes of range level or span for different operating conditions.

That Tidewater relied on Taylor for critical measurements to help protect their multi-million dollar investment is tribute indeed to the dependability, ruggedness and accuracy of these instruments.

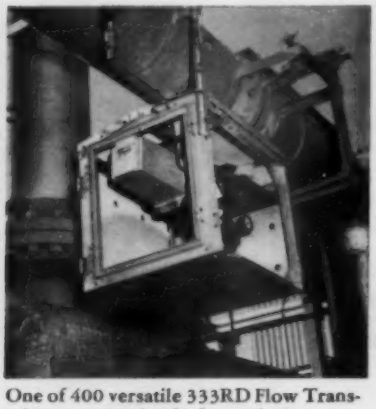
To find out how you can benefit from Taylor instrumentation, call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.



Taylor 226R FULSCOPE® Indicating Pressure Transmitter applied to a debutanizer accumulator. The slightest deviation in pressure here would be detrimental to product specification.



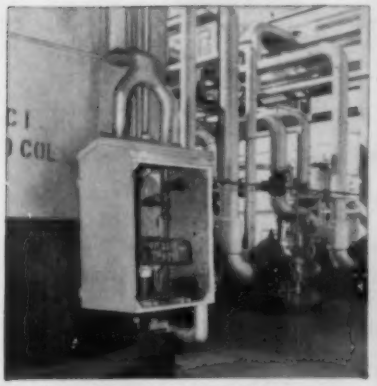
Taylor 333RD Flow Transmitters measuring the differential created by Pitot Venturi flow elements in parallel airflows responsible for carrying the catalyst to regeneration.



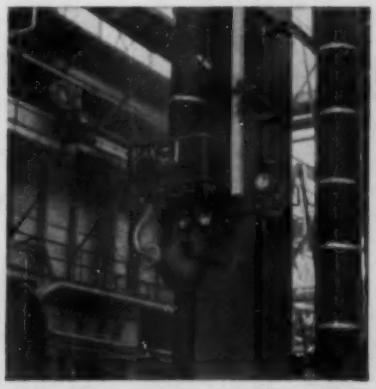
One of 400 versatile 333RD Flow Transmitters, measuring hydro-carbon vapors. Here, as in all other refinery applications, rugged dependability is especially appreciated.

Taylor Instruments

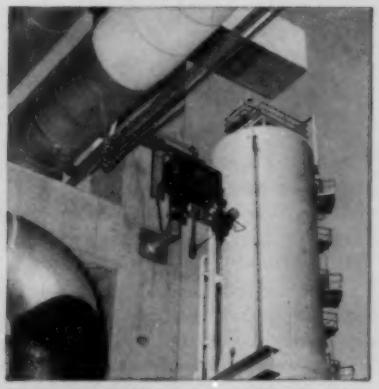
An impressive view of Tidewater Oil Company's new 130,000 bbl. per day refinery near Delaware City



Taylor 334R Level Transmitter, measuring crude unit bottom level. With this instrument increasing levels give increasing pneumatic signals even though sealing legs are used.



100 TRANSAIRE* Pressure Transmitters are used where close pressure control is essential. The suppressed narrow span permits accuracies not possible with conventional instruments.



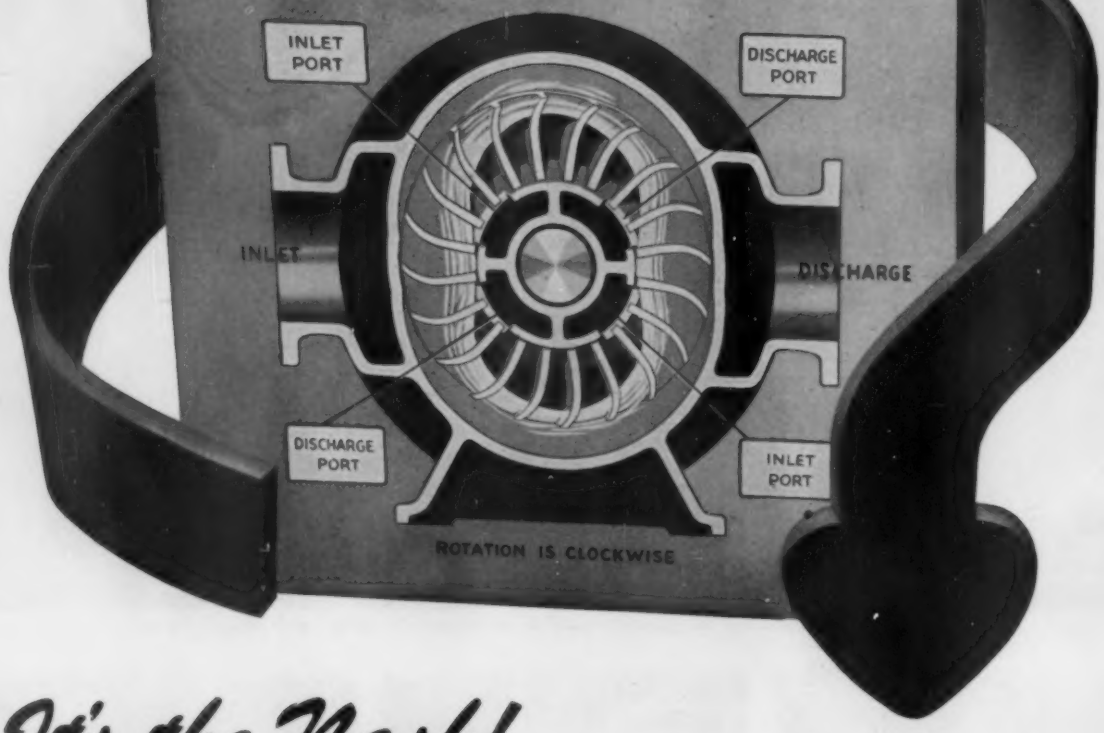
TRANSAIRE Temperature Transmitter on the crude unit, responsible for first fractionation of the crude as it enters the refinery. Note that the instrument is exposed to the elements.

*Reg. U.S. Pat. Off.

VISION • INGENUITY • DEPENDABILITY

MEAN ACCURACY FIRST

This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

313 WILSON, SO. NORWALK, CONN.

KEY® RETURN BENDS– KEY-KAST FITTINGS in service at new Tidewater refinery

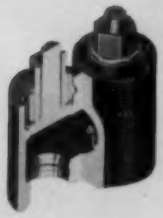
In Tidewater Oil Company's giant new Delaware Refinery, where "firsts" are commonplace, and "world's largest" describes many of the units, KEY products were chosen for their efficient, economical, long-lasting service.

The furnaces are equipped with KEY 5000 Type Return Bends. Their simple design, rugged construction mean dependable service. Only 26 parts for 18 different size fittings in two series mean substantial savings in inventory. In addition KEY 180° type "W" welding fittings were extensively used.

KEY-KAST alloy steel welding fittings in ells, tees and caps were furnished in schedules 40 and 80, sizes from 16" to 24", in low chrome moly steel.

KEY Return Bends and KEY-KAST fittings are bringing dependability and economy to refineries throughout the world. Specify KEY and KEY-KAST products for your next job.

KEY PRODUCTS SPECIFIED FOR TIDEWATER REFINERY



KEY 5000 Type Return Bend
(PATENTED)

KEY-KAST
90° Elbows

KEY-KAST Tee

KEY-KAST
180° Return
Bends.

5701

KEY Products on this project were supplied to

C. F. Braun & Co. • The Lummus Company
Foster Wheeler Corporation • Flori Pipe Co.

W-K-M
DIVISION OF acf INDUSTRIES
INCORPORATED

PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

MANUFACTURERS OF W-K-M GATE VALVES · ACF LUBRICATED PLUG VALVES · KEY-KAST ALLOY STEEL PIPING FITTINGS · KEY RETURN BENDS AND FITTINGS

RELIABLE CONTROL

Allis-Chalmers motor control in the "Refinery of the future"

More than 125 Allis-Chalmers high voltage motor controllers provide continuity of service in Tidewater's ultra-modern refinery near Delaware City.

for continuous service

MAXIMUM round-the-clock motor protection forms a major portion of the Allis-Chalmers contribution to the world's most modern refinery. The Tidewater Oil Company selected Allis-Chalmers control to help provide the reliable, uninterrupted service needed to meet a 130,000-bbl-per-day output.

Tidewater's Delaware Refinery is another major petroleum installation depending on Allis-Chalmers control for continuous day and night operation. This growing trend reflects industry confidence in Allis-Chalmers modern controllers for petroleum requirements.

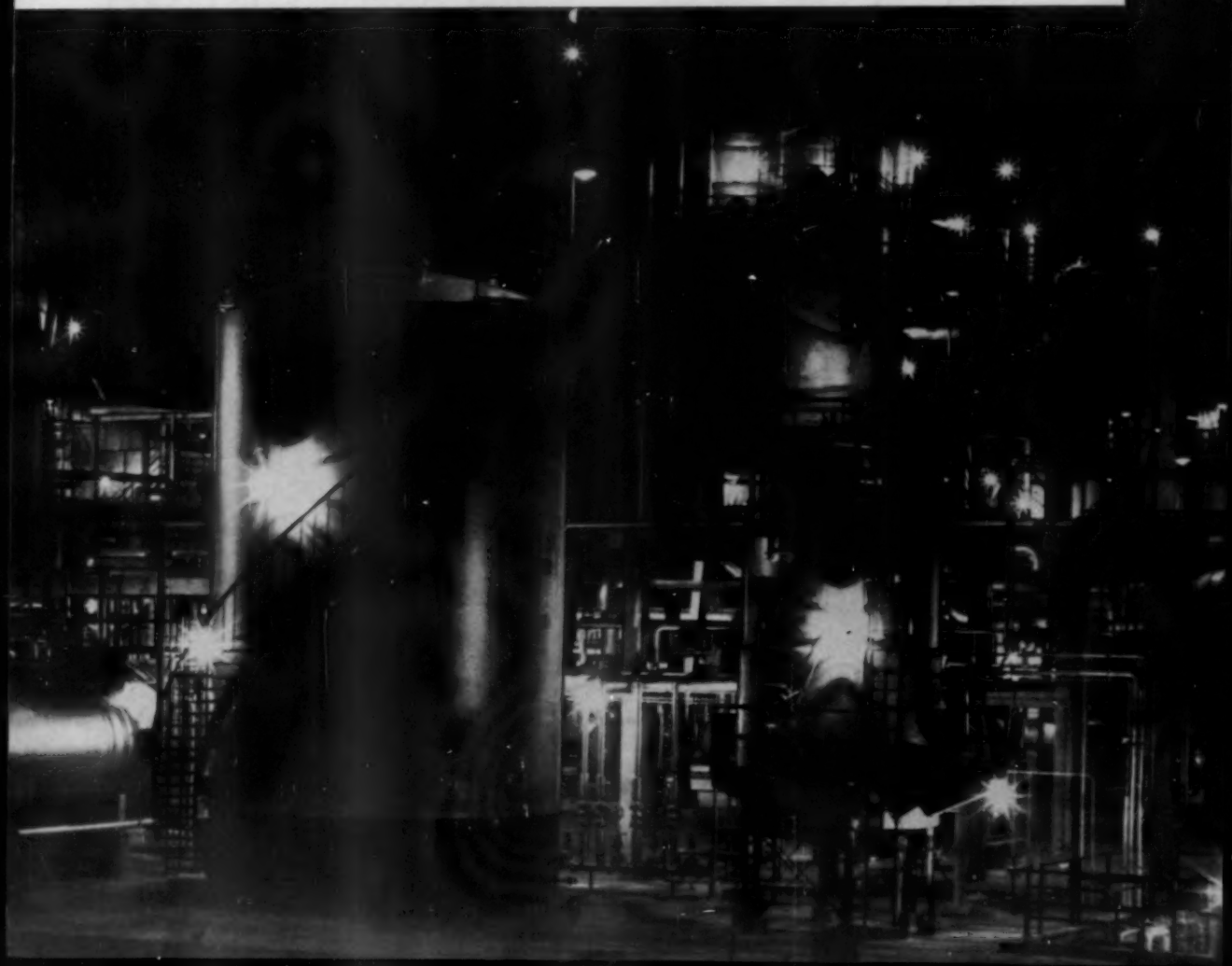
For more information about how Allis-Chalmers experience in the petroleum industry can help you, contact your nearby A-C sales office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C
ALLIS-CHALMERS

A-5430

Tidewater Oil Company Refinery. This night scene shows the 130,000-bbl-per-day crude unit, where uninterrupted service is vital to successful operation.



at Tidewater you'll find . . .

the largest UOP Catalytic

the largest UOP Udex plant

the largest UOP Unifining

Polymerization plant ever built

ever built

plant ever built

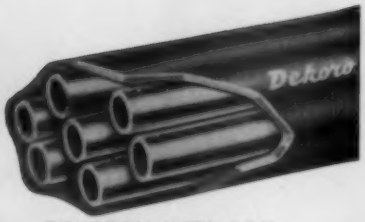
These three important processes installed on so large a scale at Tidewater, are among many significant developments Universal Oil Products Company has made available to the petroleum refining industry.

UNIVERSAL OIL PRODUCTS COMPANY
30 Algonquin Road, Des Plaines, Illinois, U. S. A.

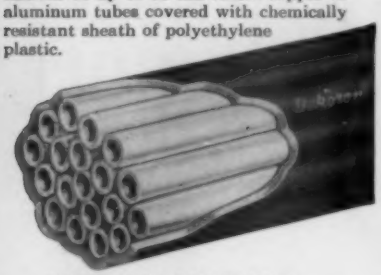
More Than Forty Years Of Leadership In Petroleum Refining Technology

Dekoron Tubing Products

slash instrumentation costs



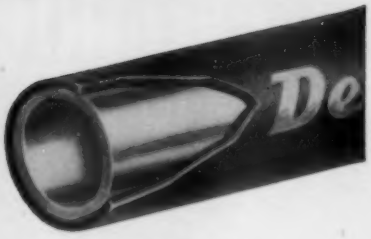
DEKORON METL-COR
Instrument line harness with tube combinations of up to 19 individual copper or aluminum tubes covered with chemically resistant sheath of polyethylene plastic.



DEKORON POLY-COR
Bundle of 4, 7, 10, 14 or 19 individual polyethylene tubes covered with vinyl plastic. Installs as easily as electric wiring.

DEKORON "M" RIBBON
10 individual copper or aluminum tubes encased in chemically resistant, perforated plastic sheath. One or more tubes can be "peeled" off without special tools.

DEKORON "P" RIBBON
Same exclusive ribbon construction as "M" Ribbon except that individual lines are made of color-coded polyethylene. For all standard instrument line pressures.



DEKORON TUBING
The original plastic-coated metal instrument tubing. Available with copper, aluminum or steel core tube. Resists chemical attack, outlasts expensive alloy tubing.

DEKORON "P" TUBING
Highest quality single-line polyethylene instrument tubing. Easy to install; requires no special tools.

Dekoron is more than a name for chemically resistant instrument tubing. The Dekoron trademark now identifies a complete line of tubing products—instrument line harness, tubing, fittings, and accessories for tubing up a pneumatic system. Dekoron products cost less to buy . . . less to install . . . last longer. *So tube up with Dekoron products—and watch your costs come tumbling down.*

Dekoron® products

QUALITY • RESEARCH • SERVICE
SAMUEL MOORE & COMPANY
DEKORON PRODUCTS DIVISION • MANTUA, OHIO

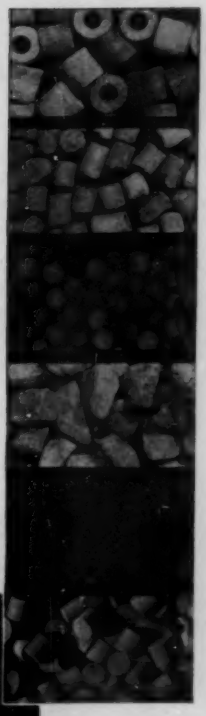
Congratulations to Tidewater!

AA-3618

FITTINGS AND ACCESSORIES
The Dekoron line includes a complete line of fittings for joining lengths of tubing, junction boxes and entry grommets, and Dekoron tubing racks.

HYDROGENATION CATALYSTS

How Girdler helps you solve hydrogenation problems



• There are three important cost-cutting ingredients in Girdler catalyst service for hydrogenation applications:

1. Girdler's *proven hydrogenation catalysts,* such as listed, which are providing optimum operating economy in a wide variety of uses.

2. Girdler's accumulated *technical know-how* which is constantly finding new solutions to difficult hydrogenation problems.

3. Girdler's extensive catalyst *facilities* . . . manufacturing, research, development and technical service . . . which provide the ideal catalyst for *your* application.

Outline your catalyst problem and we will make specific recommendations. Bulletin GC 1256 describes the full line of Girdler catalysts . . . available on request.

NICKEL CATALYSTS	Leaders in the generation and purification of synthesis gases, and for a wide variety of organic hydrogenations. Girdler's close control of reduction and careful selection of support materials impart unique properties for difficult process problems.
COPPER CHROMITE CATALYSTS	One of most highly active and versatile commercial hydrogenation catalysts. Available in regular and barium-stabilized types either as powder or especially strong pellets. Powder meets certain specific particle density requirements.
SELECTIVE HYDROGENATION CATALYSTS	Widely used to selectively hydrogenate acetylenic and diolefinic compounds in purification of olefins. Custom made to give optimum performance with due regard for process variables and contaminants. Facilitate production of high purity olefins for petrochemical processes.
COBALT MOLYBDENUM CATALYSTS	Used extensively by many refineries. Highly active. Developed specifically for sulfur conversion and for hydrogen treating to remove sulfur and nitrogen . . . also for upgrading a wide range of petroleum feed stocks. Excellent physical properties assure high operating economy and long life.
NOBLE METAL CATALYSTS	Pelletized forms of platinum and palladium catalysts for special applications. Advanced techniques produce highly active catalysts, economical both in manufacture and use.

CATALYST DEPARTMENT

The **GIRDLER** Company

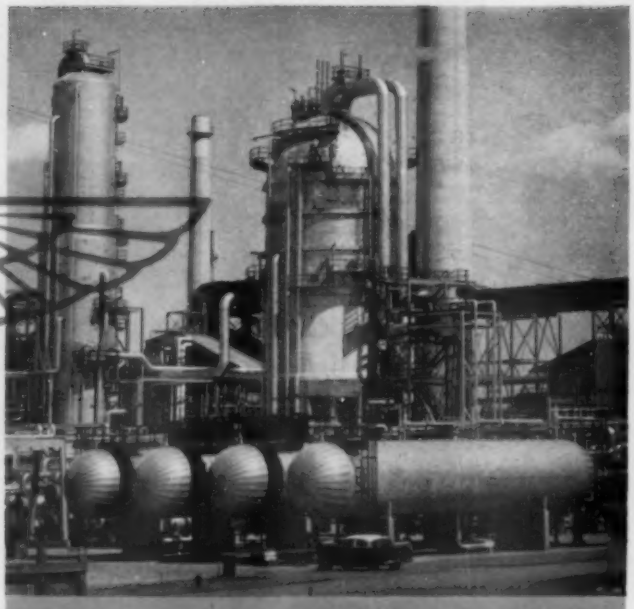
A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

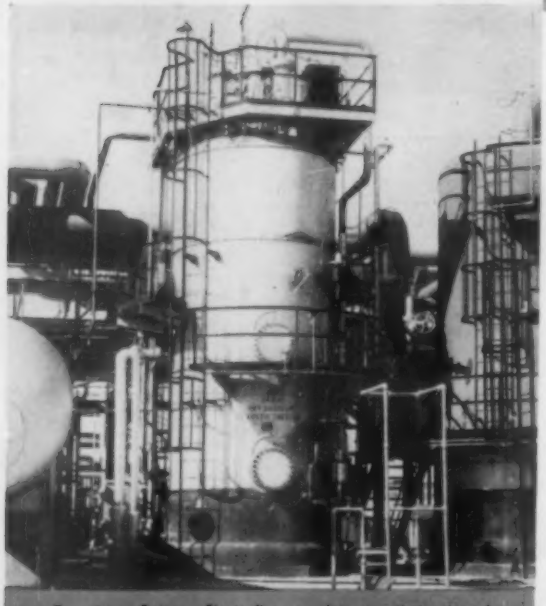
GIRDLER MANUFACTURES CATALYSTS FOR: HYDROGENATION • SYNTHESIS GASES AND HYDROGEN GENERATION • DESULFURIZATION • NEW CATALYTIC PROCESSES

again at ***TIDEWATER***

PETRECO ELECTRIC DESALTING



The Petreco Desalter in the foreground of the above photo was designed to desalt extremely salty crude to a very low salt content.



Two-stage Petreco Electrofiner used to caustic-treat and water-wash a heavy gasoline stream. Note the compactness of the unit and the small space it occupies.

AND PETRECO ELECTROFINING *are specified*

At Tidewater Oil Company's new Delaware Refinery the emphasis was definitely on *the best.* The equipment and processes used were specified with one primary objective—to create the finest, most modern refinery in the world.

Petreco feels that the specification of Petreco Electric Desalters for crude charge purification, and Petreco Electrofining for heavy gasoline caustic treating, is particularly significant.

Like other leading refiners all over the world, when Tidewater wanted the best, they specified Petreco.

PETRECO®

A DIVISION OF PETROLITE CORPORATION

3202 S. WAYSIDE DRIVE, HOUSTON 1, TEXAS • 1390 EAST BURNETT STREET, LONG BEACH 7, CALIFORNIA

PTW-57-1

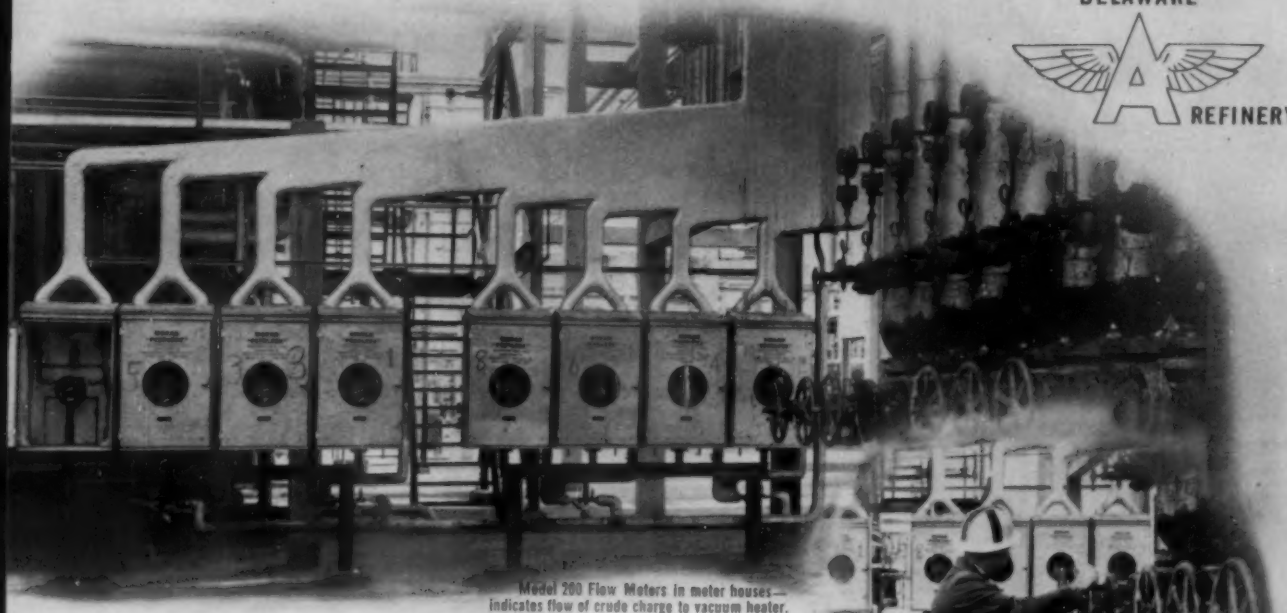
Specialized Electric Petroleum Treating

DESALTING • DEHYDRATING • CAUSTIC WASHING • ACID TREATING • DOCTOR TREATING • SWEETENING • NAPHTHENIC ACID REMOVAL • SEDIMENT REMOVAL

BARTONS working for TIDEWATER'S

DELAWARE

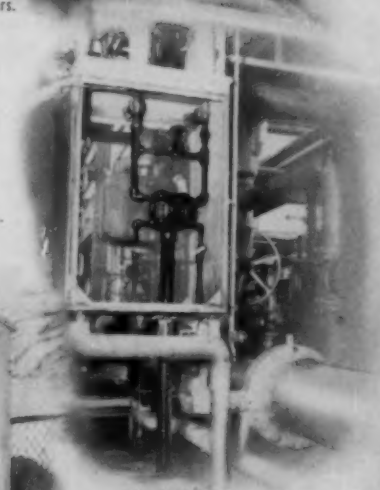
REFINERY



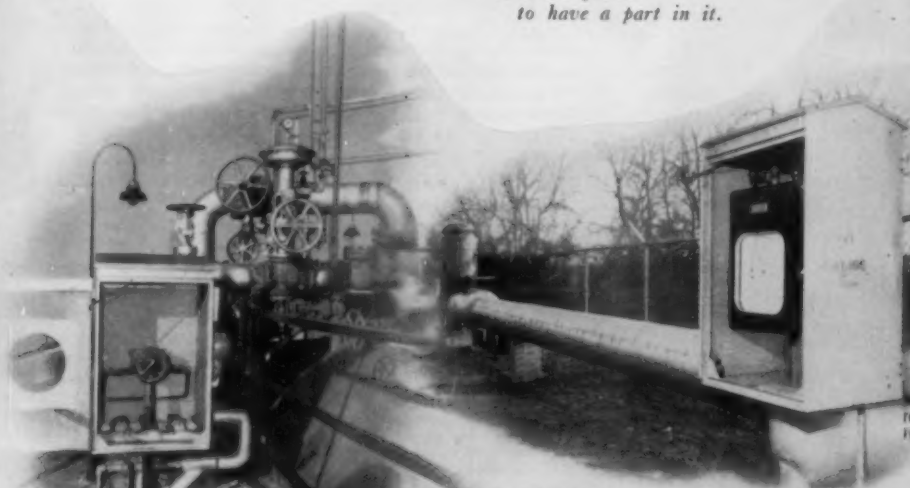
Model 200 Flow Meters in meter houses—indicates flow of crude charge to vacuum heater.

Altering flow of crude charge while observing change on the indicators.

BARTON is pleased to have been selected by Tidewater Oil Co., and C. F. Braun & Co. to work with them on the instrumentation of this modern Refinery. Because of their constant zero and stable calibration under varying temperatures and elevated pressures, BARTON Differential Pressure Units were chosen for use on all flows for accounting service. In addition, units are being used on flow measurement both for local visual operation and for transmission to the Control Room to dictate to the central information, logging and control systems which put into practice the newest techniques in process instrumentation. We are proud to have a part in it.



Model 199 Differential Pressure Unit on Taylor Transmitter—measures, indicates and transmits flow of stripping steam to cracker fractionating tower.



Model 202 Flow Meter—records water flow from remote well station.

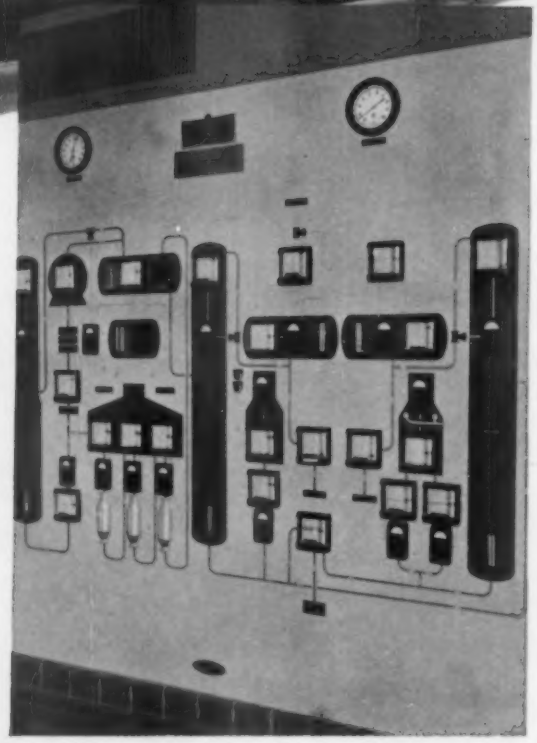
Model 200 Flow Meter—indicates flow of snuffing steam to cyclone at top cracker regenerator.

For better measurement, try BARTON — a complete line of rupture-proof bellows-type meter bodies, indicators, recorders, switches, transmitters, controllers and integrators for precise measurement of flow, liquid level and differential pressure.

BARTON INSTRUMENT CORPORATION

580 MONTEREY PASS ROAD, MONTEREY PARK, CALIFORNIA

THIS REFINERY GOES ELECTRONIC...



Pontiac Refining Company in Corpus Christi installed a new reformer in 1956 to produce 100+ octane gasoline. Because distances from the control house to the process range up to 800 feet and some of the variables were difficult to control, 'American-Microsen' Electronic Instruments were selected.

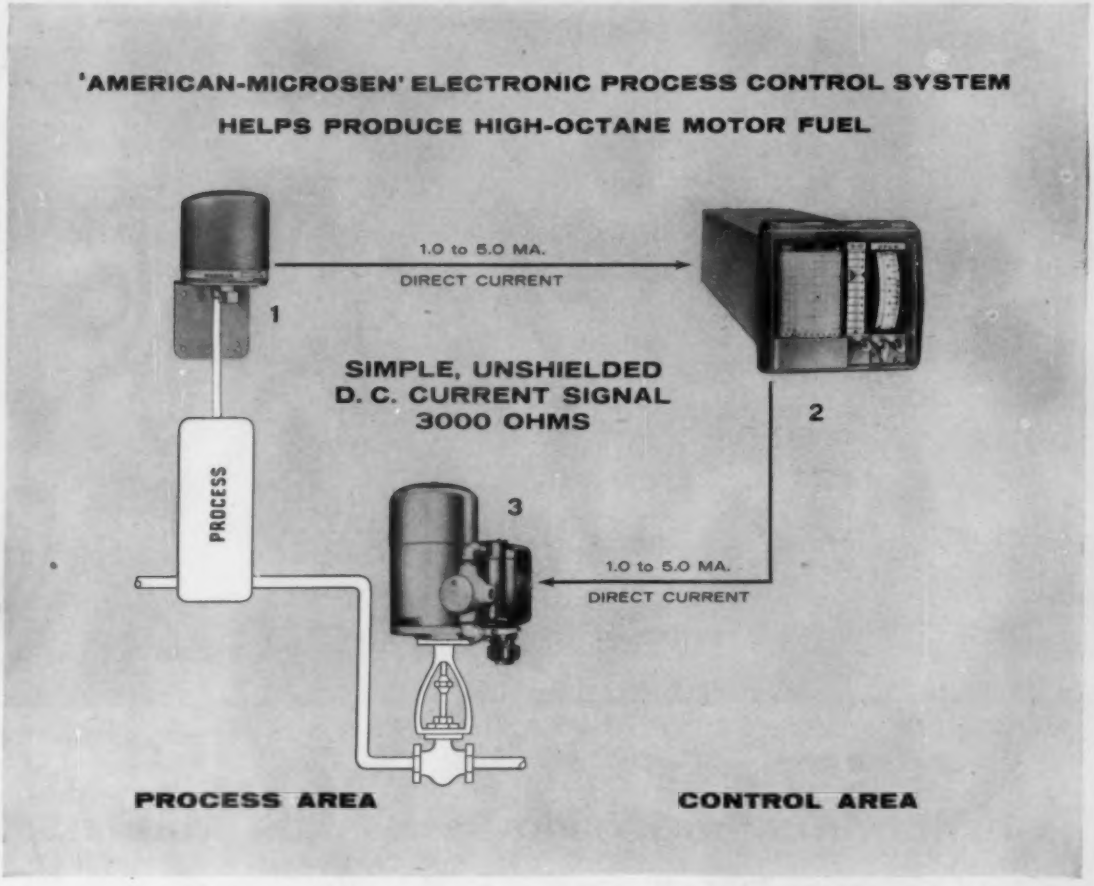
The control house contains 'American-Microsen' Controllers for pressures, flows, levels, and temperatures of the process materials at vital stages of the platforming process. Despite the long distances and fast-acting variables, the instruments provide control well within the tolerances required to produce high-octane motor fuel.

Such results are possible because the 'American-Microsen' System is completely electronic, with dc transmission signal that is insensitive to distances as great as 30 miles. The high speed and sensitivity of the electronic design improve the control of all process variables.

Now in operation over a year at Pontiac Refinery, the 'American-Microsen' System continues to give complete satisfaction — continues to help turn out high grade motor fuel. It is typical of many successful installations, and more and more companies are specifying the system for new plants as well as in modernizing existing processes.

Even though the electronics approach in process control is revolutionary, the 'American-Microsen' System of today incorporates the latest design techniques. Transistors are used for the ultimate in reliability and service life, and printed circuits and miniaturized components provide space-saving simplicity. The complete process control system now uses only three units.

the modern way to control process variables



1. **TRANSMITTER.** 'American-Microsen' transmitters are used for measuring pressure, temperature, differential pressure, liquid level, flow, and other process variables. The "Microsen" balance creates a stable dc signal for long distance transmission. Transmitters have a minimum of bearing pivots or linkages—assuring sensitivity and repeatability of measurement.

2. **CONTROLLER.** A single unit combines all functions of measuring and recording or indicating the input signal; producing the control signal; and allowing manual-automatic process operation. Separate plug-in chassis provides the following functions: A. Records or indicates process variable. Strip or card chart recorder chassis available. B. Produces proportional, reset and rate control actions to regulate the variable. All control settings are calibrated. C. Permits switching to manual operation during start-up or emergency conditions, with true "bumpless" transfer from manual to automatic control.

3. **ELECTRO-HYDRAULIC CONTROL VALVE OPERATOR.** A power unit with position feedback that operates slip-stem control valves. No compressed air is needed. Mountable on standard yokes supplied with conventional slip-stem control valves with bodies of single or double-seated construction, with V-port, parabolic, needle and equal percentage plugs, including valves of 4" stroke, and force available up to 3,250 lbs.

Where required, the 'American-Microsen' Electro-Pneumatic Valve Positioner or the Electro-Pneumatic Transducer can be supplied.

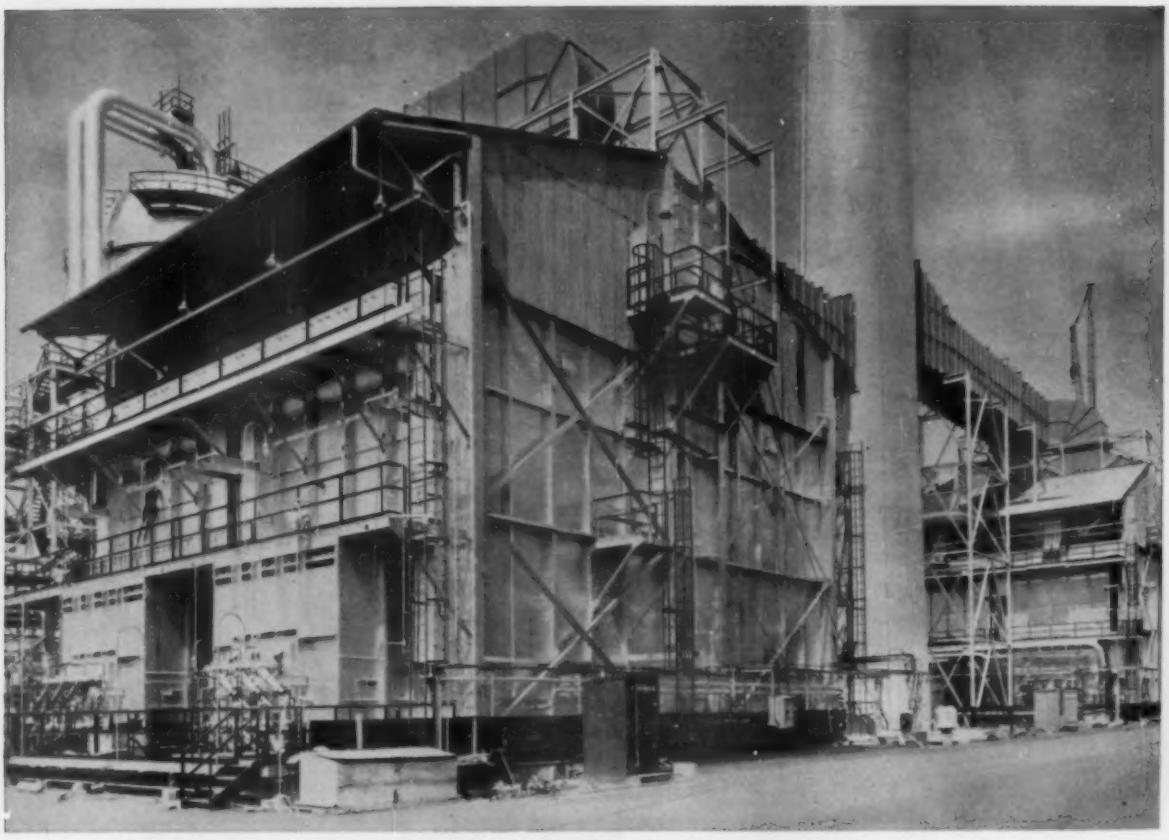
In automating your processes for higher product quality and greater operating economy, you want the better control and simplified servicing provided by the 'American-Microsen' Electronic Process Control System. We invite you to meet with one of our sales engineers to determine the best equipment for your service. Write for literature.

MANNING, MAXWELL & MOORE, INC.

MAXWELL MANNING MOORE INC. TRADE MARK

INDUSTRIAL CONTROLS DIVISION • STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL



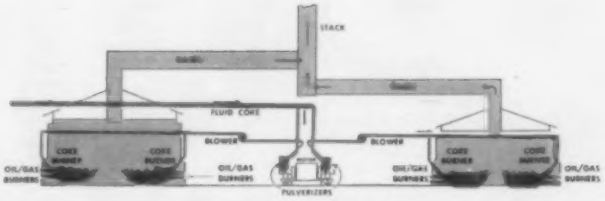
357,000,000 btu/hr

from two FW direct-fired oil heaters designed to burn FLUID COKE

SUPPLYING the heat requirements of the world's highest capacity crude distillation unit at the new ultra-modern Delaware Flying A Refinery of Tidewater Oil Company, the two Foster Wheeler direct-fired oil heaters shown above have a heat absorption capacity of 357 million btu per hr. The petroleum industry's first direct-fired heaters designed to burn fluid coke, they are capable of heating 130,000 bbl of crude per day.

Fluid coke can be burned at the rate of approximately 220 tons per day, supplying one half of the total direct heat requirements when operating at full capacity. Fuel oil or gas burning will supply the other half.

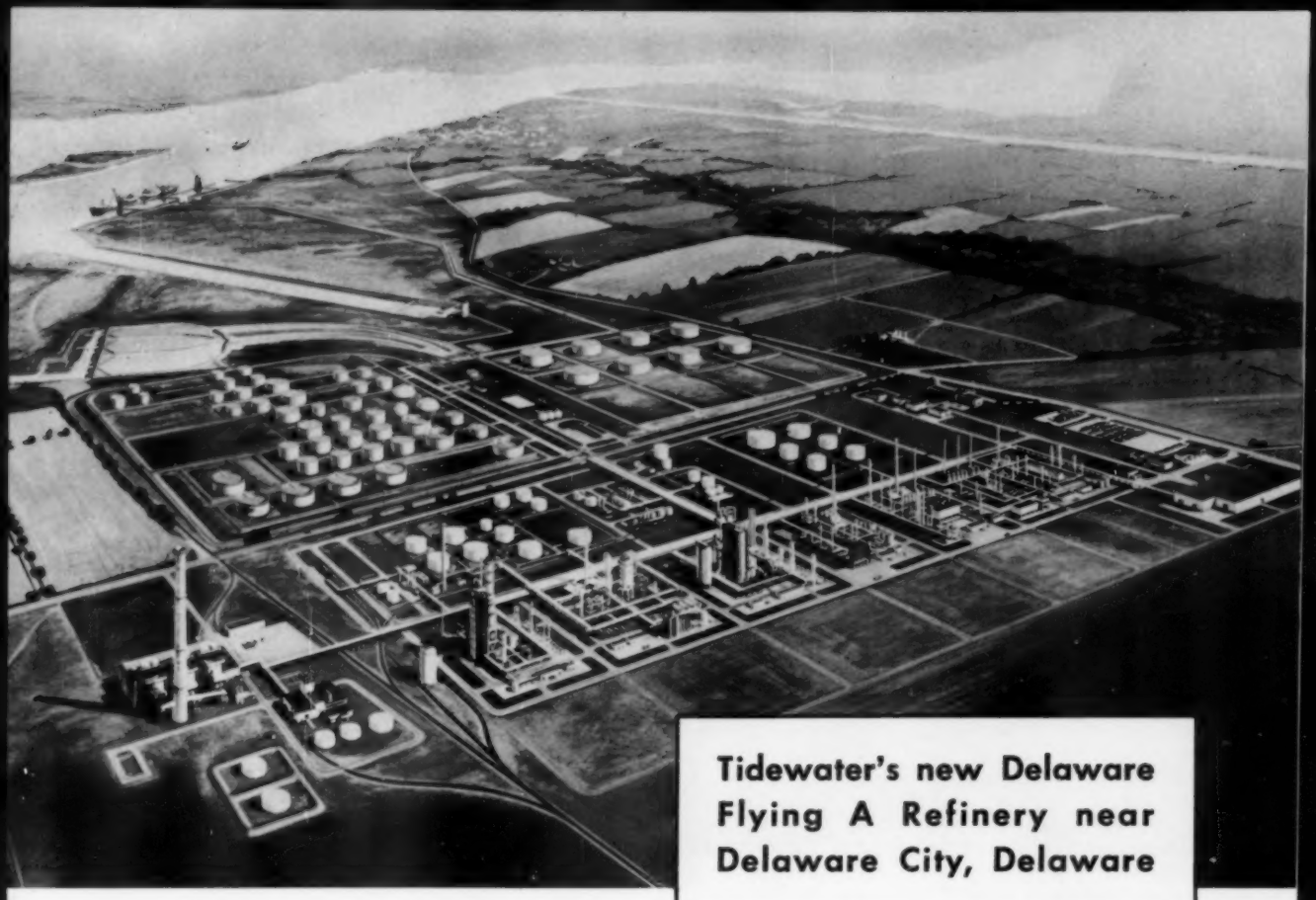
This installation is another example of Foster Wheeler's ability to design and construct direct-fired heaters of exceptionally high heat-duty requirements. This specialized



experience can help you save time and expense in meeting your exact requirements for special heating and vaporization units. For full details on the 357,000,000 btu/hr units above, send for the Nov.-Dec. Heat Engineering. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



Tidewater's new Delaware Flying A Refinery near Delaware City, Delaware

Electricity... instead of steam... powers most of refinery processing equipment

Unique electrical distribution system provides outstanding power continuity

Tidewater Oil Company's new 130,000-barrel-per-day Delaware Flying A Refinery in Delaware, designed and constructed by C. F. Braun & Co., is of special interest because of the high degree of dependence placed on the electrical distribution system. This is especially significant since it is the world's most modern refinery, with the largest initial capacity of any refinery yet built.

With continuity of power a "must"—for even a power failure of a few seconds cannot be tolerated—the problem was to work out systems and components which would set a new high in continuity of operation.

In doing this, certain motors were modified for 250% breakdown torque at normal voltage to meet the special requirements for reacceleration after a fault. It was then necessary to design the control with low drop-out characteristics.

This meant the closest type of relationship was required between all the Allis-Chalmers engineering departments concerned, and C. F. Braun & Co., prime contractors for the tremendous project.

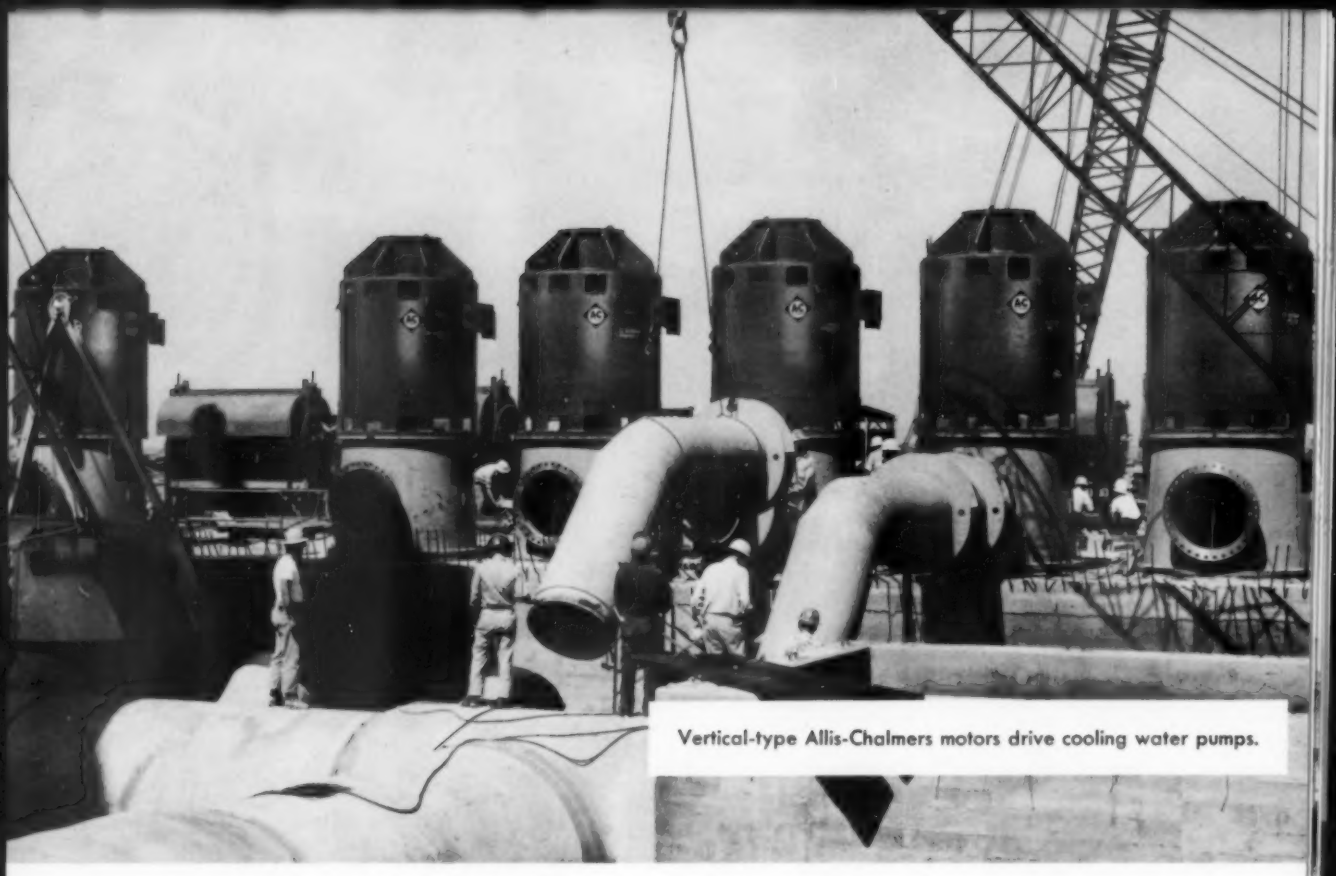
As on other complex jobs, group effort was used to provide coordination between departments, and to take advantage of the variety of experience in each department. Conference phone calls were used to handle matters of delivery and design modifications that came up during construction. In this way, problems could be considered quickly and decisions made immediately.

A network analyzer was used extensively to study the effect on the system of the worst possible faults, thus saving months and months of calculations.

Experience and coordination like this is available to you on applications involving Allis-Chalmers broad line of electrical equipment. Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

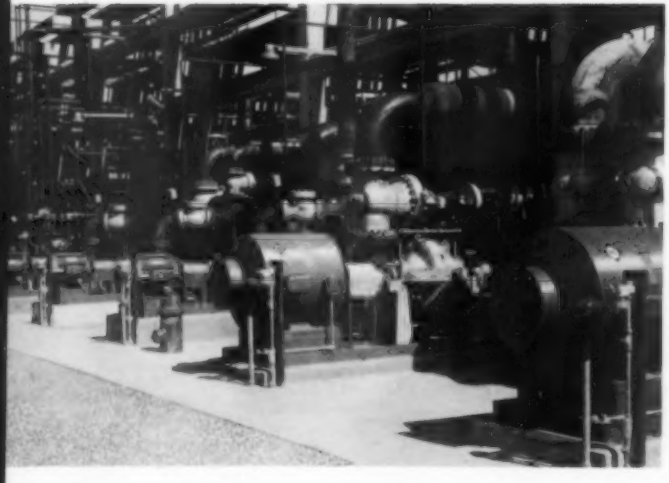
ALLIS-CHALMERS

A-5247

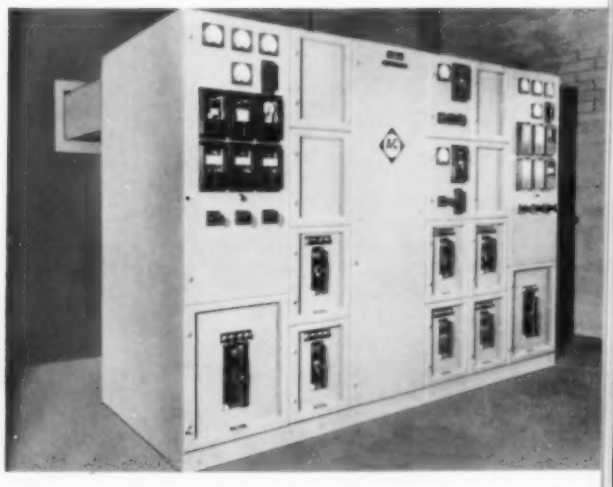


Vertical-type Allis-Chalmers motors drive cooling water pumps.

Electricity at work throughout



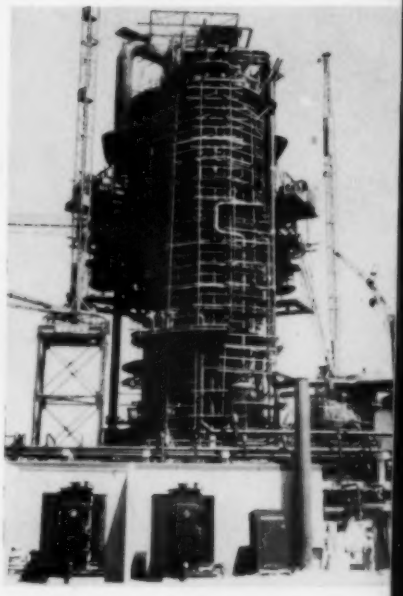
A few of the 300 Allis-Chalmers motors used for driving pumps, compressors and other equipment. Motors in foreground feature tube-type, air-to-air heat exchanger.



Allis-Chalmers new low voltage switchgear incorporates selective trip, an absolute requirement on the job, in addition to its many other features.

ALLIS-CHALMERS

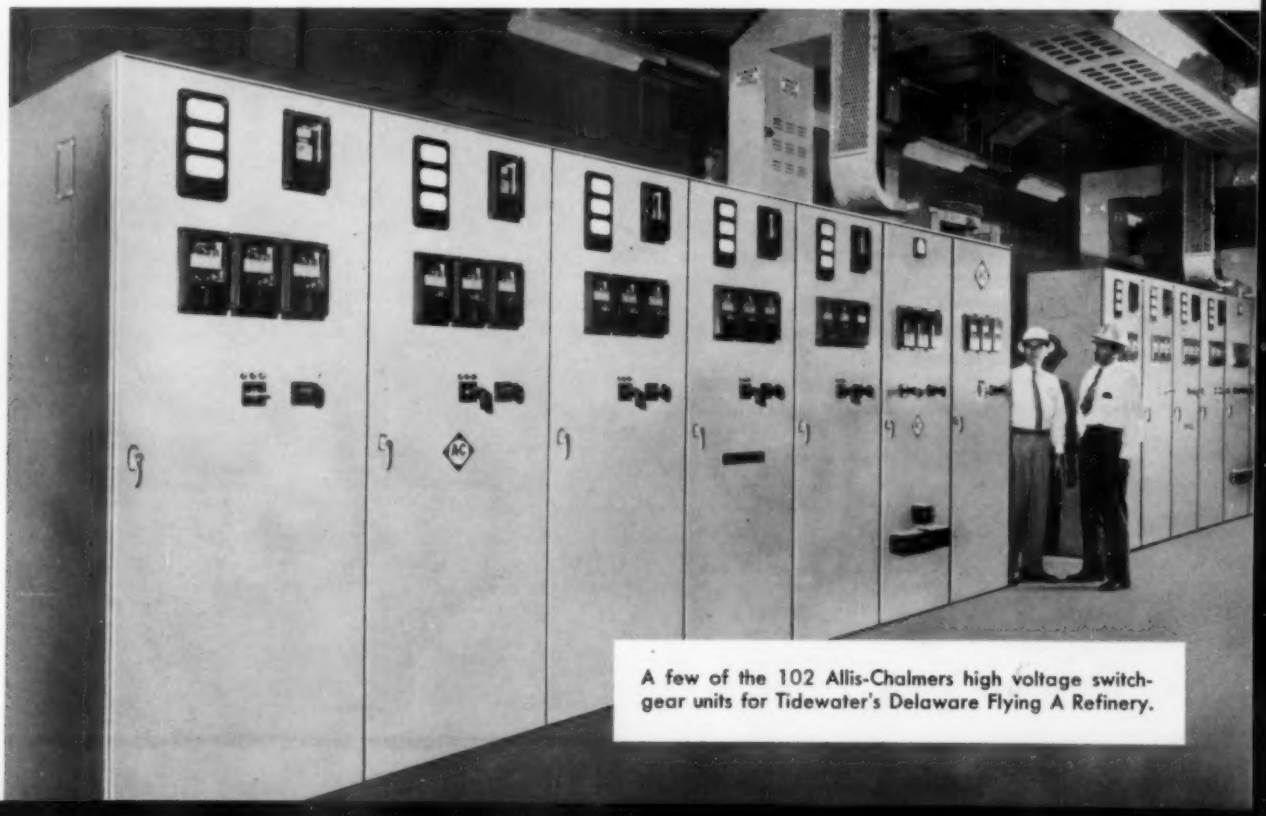
All the motor control and switchgear are located inside switch houses. These buildings are pressurized to exclude explosion vapors. Bus duct systems are pressurized.



All transformers are oil-insulated, sealed-tank construction with welded-on tubular radiators. They are equipped with high voltage disconnecting switches, capable of breaking magnetizing current. Fan motors are explosion-proof.

Teamwork! A part of the Allis-Chalmers coordinating team is shown during one of frequent meetings.

Tidewater's New Refinery



A few of the 102 Allis-Chalmers high voltage switchgear units for Tidewater's Delaware Flying A Refinery.

More than 125 high voltage motor controllers are used at the new Delaware Flying A Refinery.

Motor Control is one of the Key Factors in assuring Power Continuity

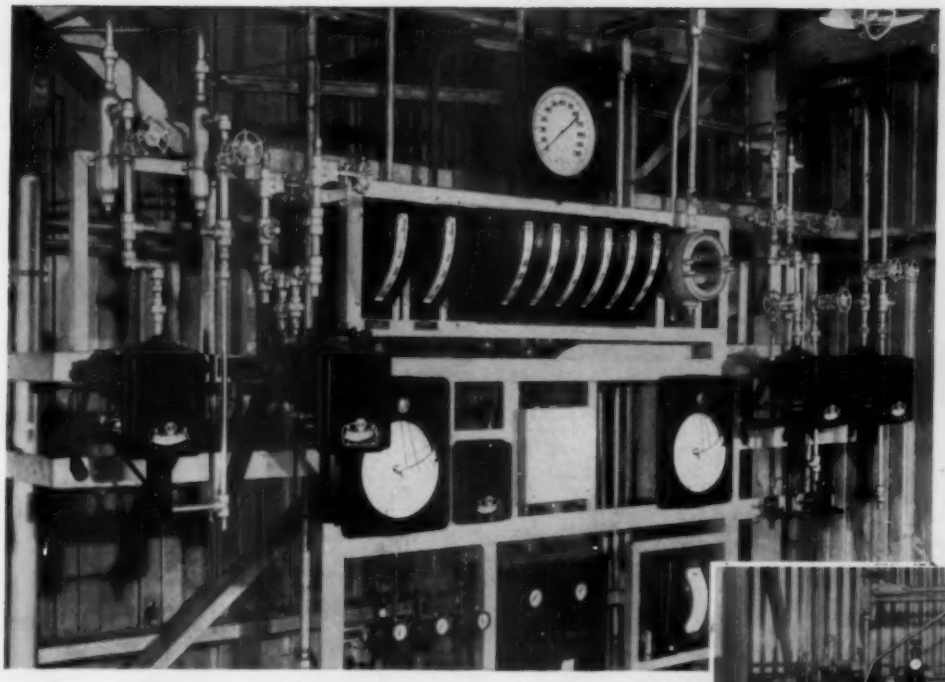
To permit motors to remain on the line through severe system voltage disturbances, important design developments were made in both the 2300-volt motor control circuits and main motor starting contactors.

The magnetic circuit of the high voltage air contactor was redesigned so that it would remain closed, even though magnetically held, for a period of 19 cycles after complete loss of power. In addition, the magnetic circuit remains sealed even when the voltage drops to 35% of normal.

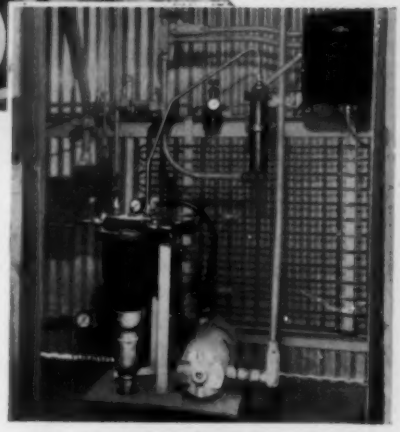
Get details! These developments are important wherever continuity of operation is vital. Allis-Chalmers engineers can help you. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Two separate studies were made using a network analyzer. Teams from Allis-Chalmers and C. F. Braun & Co. worked together to assure power continuity.

ALLIS-CHALMERS



These Bailey Pneumatic Transmitters on CO boiler at Tidewater measure and transmit: Fuel gas flow, drum level, per cent oxygen, steam pressure, furnace temperature, CO gas flow, steam flow, duct and furnace pressures. Other Bailey transmitters (not shown) measure feed water flow, oil flow, air flow, and steam temperatures.



Bailey Gas Analyzer for oxygen and combustibles in flue gas.

Bailey Control for CO Boiler at Tidewater...

Bailey Instruments and Controls help Tidewater Oil Company to secure design performance from the new carbon monoxide boiler in its Delaware Refinery. The Bailey Equipment here is of the pneumatic transmission type operating on a standard 3-15 psi signal range. This allows a wide selection of receiving instruments for control room service.

Bailey Controls on the CO Boiler function to maintain:

1. Steam Pressure
2. Steam Temperature
3. Elevated Furnace Temperature for combustion of CO
4. Optimum fuel-air ratio for all mixtures of CO and supplementary fuels
5. Safe water level in boiler drum
6. Proper differential between pressures in boiler drum and at feed water pump outlet
7. Circulation through boiler feed pumps.

For combustion "know-how" with standardized instrument and control components, see your local Bailey Engineer or call our headquarters at Cleveland.

CP2-1

BAILEY BUILDING BLOCK METHOD

BAILEY METER COMPANY

CHEMICAL AND PETROLEUM DIVISION

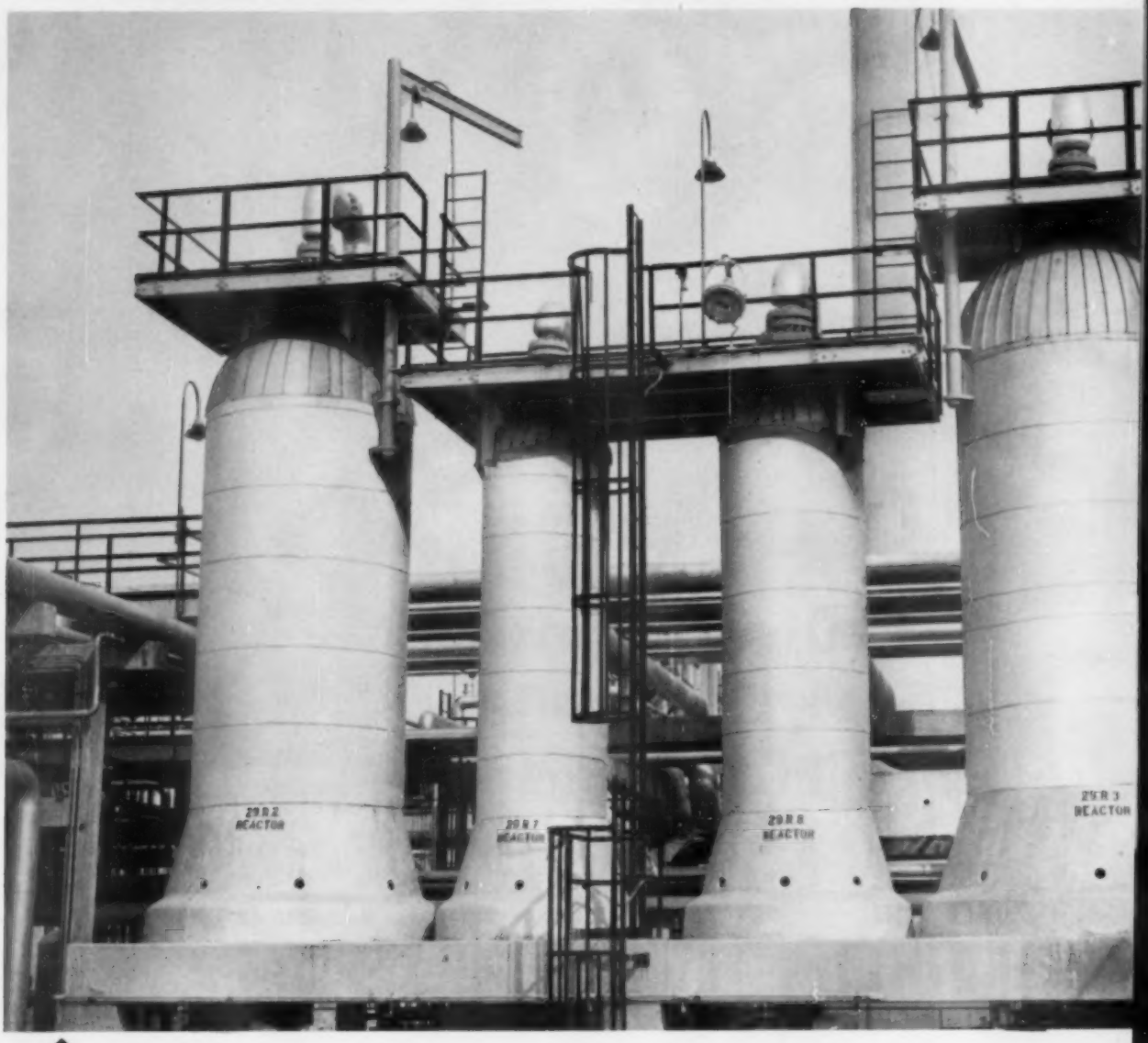
1086 IVANHOE ROAD, CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

RESULTS IN: FLEXIBILITY, SIMPLICITY, ECONOMY

BAILEY METERS

How we work steel to make steel work for you



Here are four of the nine reactors built by A. O. Smith for a desulfurization unit at Tidewater's tremendous new Delaware Refinery.

Seven A. O. Smith counter-equipped WPM-2 petroleum meters like this keep track of gasoline additives at the Delaware Refinery.

Want more facts about A. O. Smith products for the petroleum industry? Write today for free, illustrated brochure, "OIL."

Pressure vessels, heat exchangers

Gasoline dispensers, liquid meters

Glassteel processing equipment

Air view illustrates the vastness of Tidewater Oil Company's new Delaware Refinery. Installation incorporates many advanced features. These include processing units that are among the largest ever built anywhere.

Building partners for petroleum progress

A. O. Smith supplies reactors and meters for Tidewater's great, new refinery

SINCE producing the world's first electric arc-welded refinery pressure vessel in 1925, A. O. Smith has been proud to participate in the petroleum industry's remarkable growth.

Tidewater Oil Company's vast, new Delaware Refinery installation marks another milestone in this participation. Contributing to the refinery's tremendous 130,000-barrel-per-day output is a desulfurization unit that features nine A. O. Smith reactors. Precision-built to Tidewater's exacting specifications, these alloy-lined vessels range in length from 18 to 28 feet (seam to seam). Wall thicknesses are from $1\frac{13}{16}$ to $4\frac{9}{16}$ inches . . . and design-pressures range from 860 to 890 psi.

In addition to the nine reactors, A. O. Smith supplied Tidewater with seven WPM-2 meters. Exclusive rotary displacement design assures accuracy. These petroleum meters are used to measure gasoline additives.

Building partners for petroleum progress — from well-site to retail outlet — A. O. Smith works steel to make steel work for you.

Welding machines, electrodes, and accessories

Line pipe, oil well casing

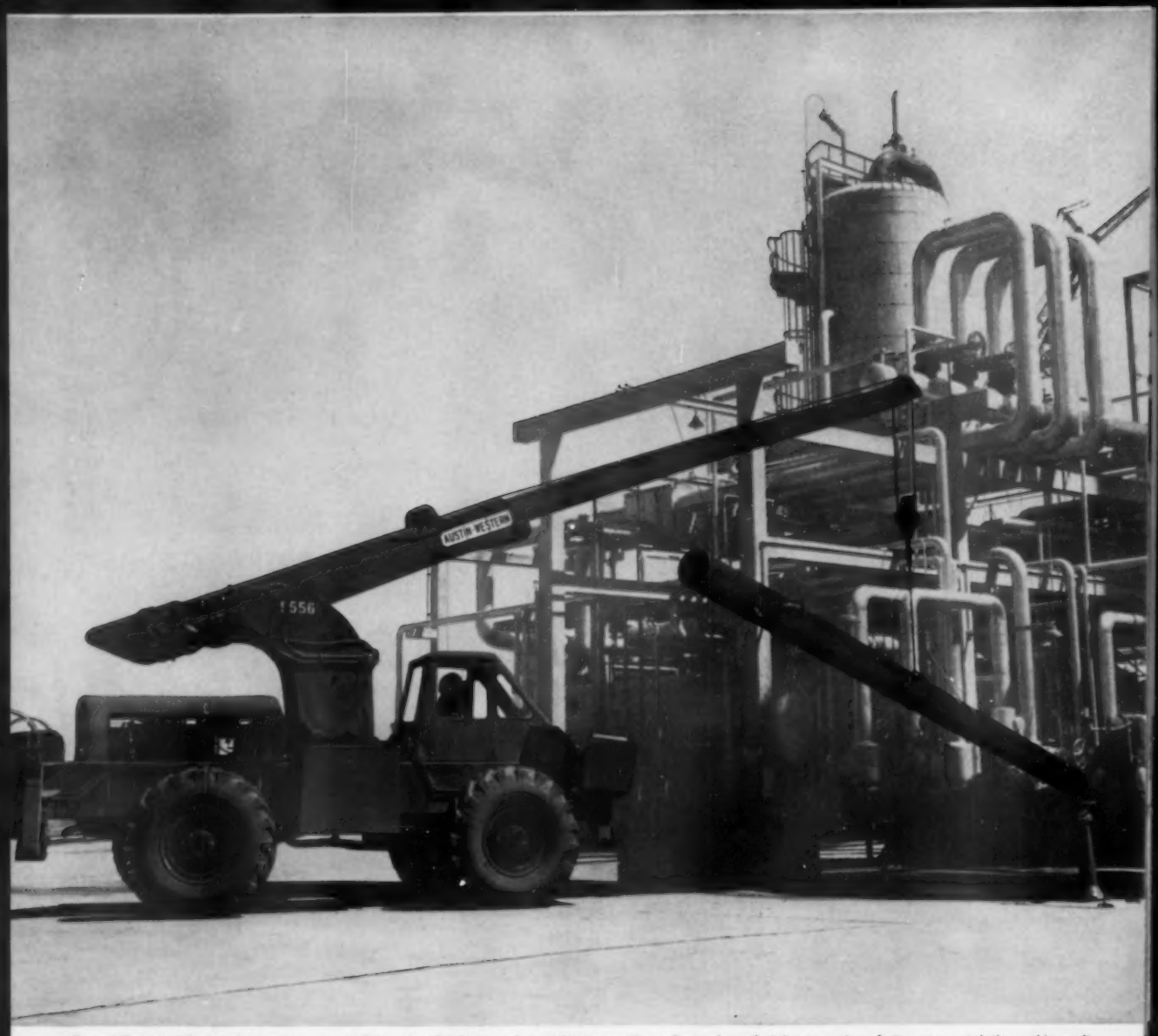
Through research A.O. Smith *. . . a better way*

A.O.Smith

CORPORATION

MILWAUKEE 1, WISCONSIN

Where creative skill with steel serves you through better products and processes for home, farm, industry and government.



One of 7 Austin-Western hydraulic cranes at Tidewater Oil Company's new Delaware City refinery shown hoisting a section of pipe at a catalytic cracking unit.

AUSTIN-WESTERN HYDRAULIC CRANE

One of Tidewater's most versatile construction and maintenance tools

Thirty-six Austin-Western hydraulic cranes helped build Tidewater's giant refinery near Delaware City, Del., and seven are now steadily employed handling materials and speeding repairs. They are among the most versatile construction and maintenance tools Tidewater has, and new jobs are being found for them every day.

Here are some of the ways Austin-Westerns save time and money on refinery operations: they remove heat exchanger heads and tubes quickly, eliminating the need for a larger crane or chain blocks; lift and transport pumps into the machine shop for repairs, spotting them precisely; unload freight cars, using their long, live booms fast and efficiently; transport materials with ease under lines in pump alleys and around pumphouses, over railroad tracks, in and out of buildings.

Find out how the flexible Austin-Western hydraulic crane can help you. See your nearby distributor or write direct.

Power graders • Motor sweepers • Road rollers • Hydraulic cranes

BALDWIN BLH LIMA-HAMILTON

AUSTIN-WESTERN WORKS
BALDWIN - LIMA - HAMILTON
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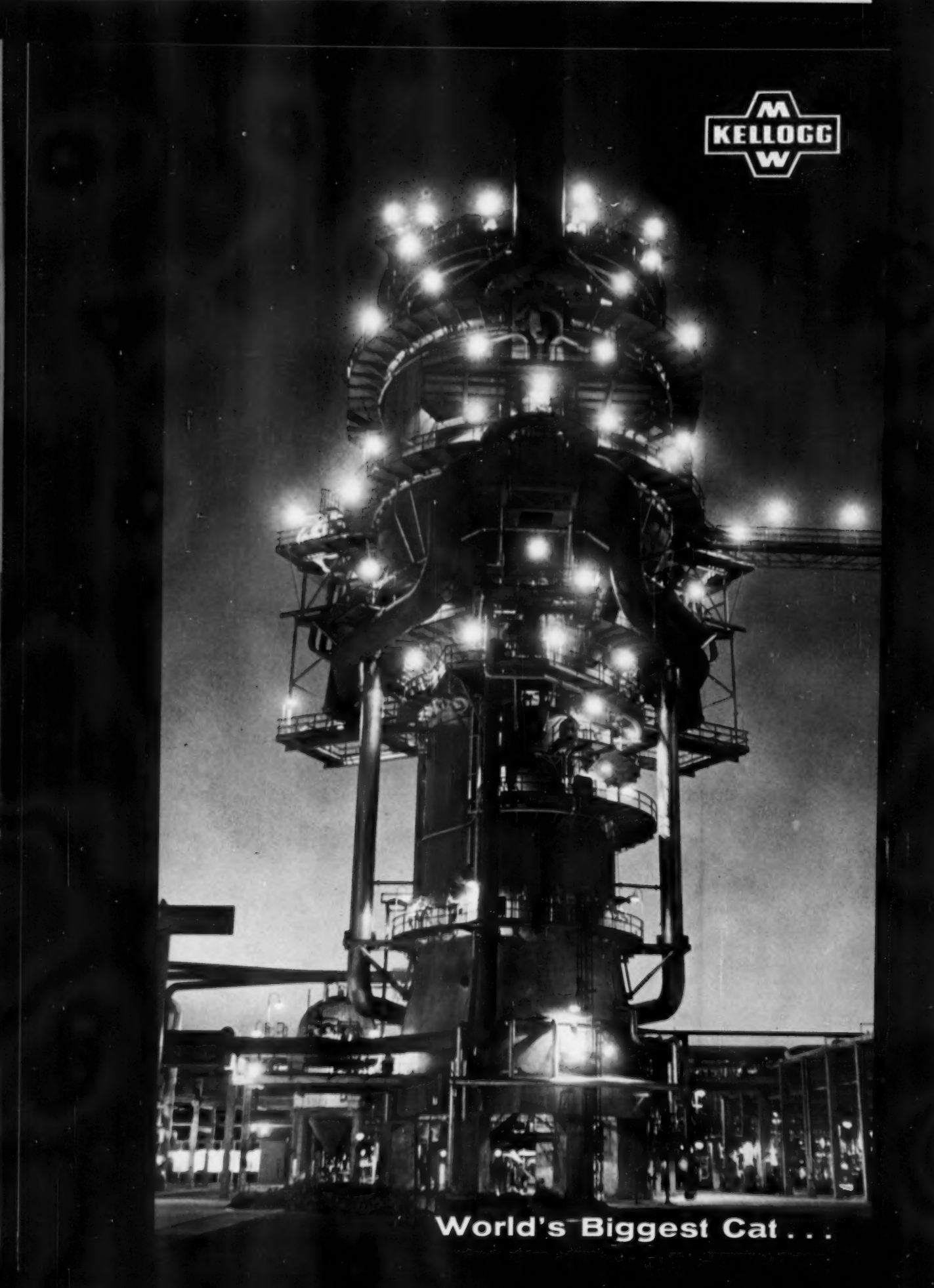

M
KELLOGG
W
World's Biggest Cat . . .

...Tidewater Oil Company's New

Orthoflow®

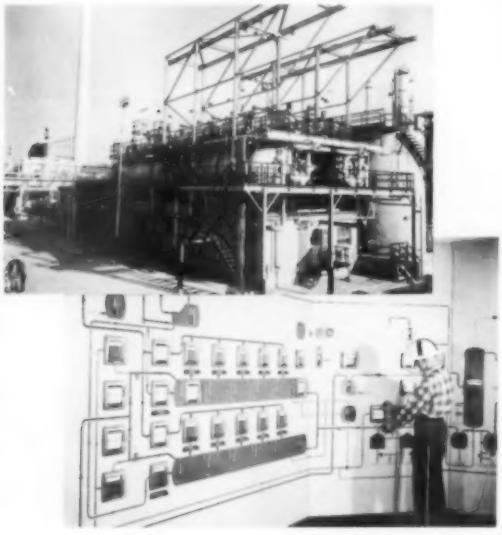
FLUID CATALYTIC CRACKER

developed and engineered

by The M. W. Kellogg Company

A throughput capacity of 102,000 BPD makes the Orthoflow Fluid Catalytic Cracking Unit, shown here and on the preceding page, the largest in the world. Engineered by The M. W. Kellogg Company for Tidewater Oil Company's Delaware Refinery, south of Wilmington, this Orthoflow is the culmination of Kellogg's experience in engineering 66 fluid catalytic cracking units throughout the world, of which 16 are Orthoflow units.

Kellogg welcomes the opportunity of demonstrating to other refiners, as it did for Tidewater, the numerous advantages of the Orthoflow design.



Kellogg Also Developed and Engineered Tidewater's Sulphuric Acid Alkylation Unit

With a design capacity of 5,000 BPD of alkylate, and a potential capacity of 9,000 BPD, Tidewater's alkylation unit at the Delaware Refinery is one of the largest in operation. Interior view shows controls for the two 5-stage reactors.

Refinery Process Division

The M. W. Kellogg Company

711 Third Avenue, New York 17, N. Y.

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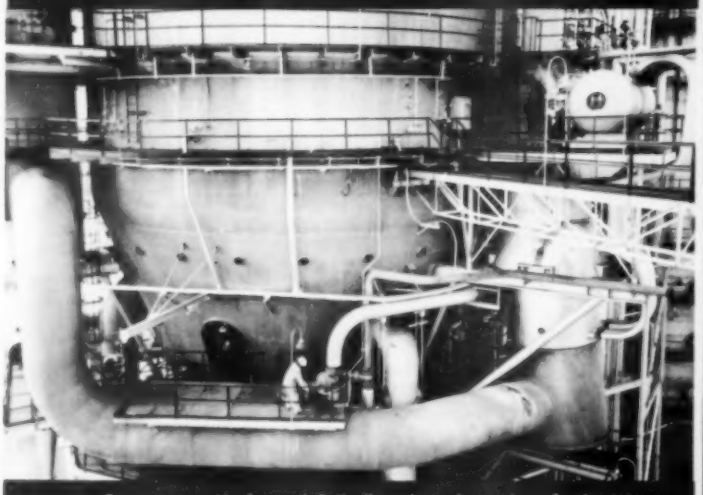
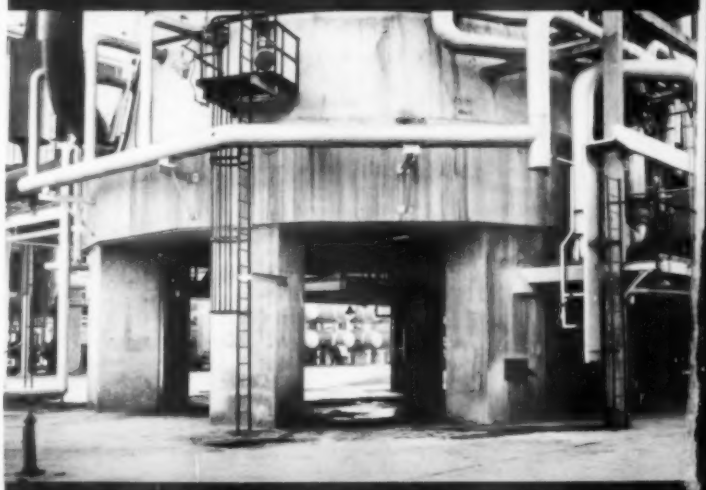
Kellogg Brasileira, Rio de Janeiro · Compania Kellogg de Venezuela, Caracas

Atop Tidewater's Orthoflow Cat Cracker—25 stories high



Operator on platform of Orthoflow shows huge size of unit



Base of Orthoflow typifies its compact, functional design

PHOTO COURTESY OF C F BRAUN & CO
ENGINEERS AND CONSTRUCTORS

PACIFIC PUMPS INC was selected to supply practically 100% of TIDEWATER'S centrifugal process pumps for their new DELAWARE REFINERY

Pacific's world-wide reputation for engineering pumps with outstanding performance and service records was further evidenced by Tidewater's choice. We are justly proud of this opportunity to put more Pacific pumps to work for Tidewater at Delaware as we have at their Avon, California refinery. It is our feeling that our excellent pump service engineering staff (always available when needed, anywhere, anytime) also influenced their decision. Whatever your pumping requirements—it will pay you to consult Pacific.

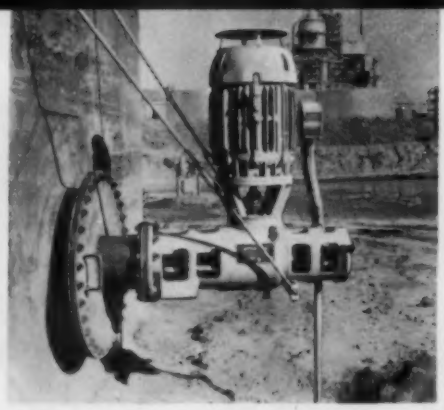
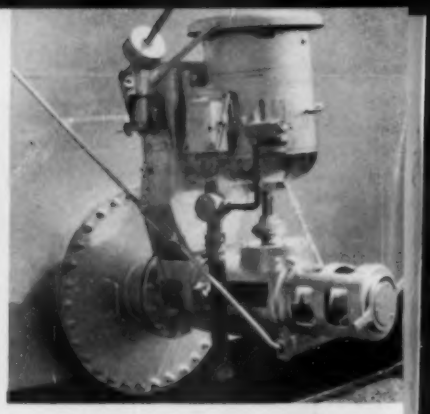
PACIFIC

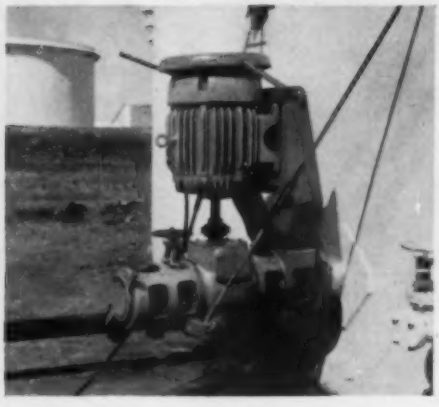
PACIFIC PUMPS INC.

HUNTINGTON PARK, CALIFORNIA

Offices in all Principal Cities

CP-17



Puzzle: *find the mixer that costs least to operate*

Specifying the *right* mixer for blending, TEL addition, or crude oil sediment control may *look* like a puzzle—but it doesn't have to *be* one.

Simply look for the mixer that gives you *most choice* for the money. That's the one most likely to give you the long-run economy you're seeking.

For example, if corrosion is a problem, you'll want a free hand in choosing the material for the mixer shaft and propeller. It's good to know you can get these parts in *any* machinable metal or alloy (and with special covering, if you want it) —when your choice is a LIGHTNIN Mixer.

Leak-free sealing—Perhaps you've taken a close look at maintenance costs, and decided you'd like a mixer with a rotary mechanical shaft seal instead of a stuffing box. You can get such a seal on any LIGHTNIN Side Entering Mixer (it's saving many oil companies thousands of dollars a year on maintenance). Or you can take your pick of *four* standard packed stuffing boxes, two of which permit repacking without draining the tank.

Choice of power input—What's your preference on mixer drive units? You can choose a highly efficient gear drive, or a lower-cost V-belt drive, for your LIGHTNIN Mixer. On gear-drive LIGHTNINS, you can have a fluid coupling between motor and drive to handle excessively high starting torques.

You want a mixer big enough to handle the job. But you *don't* want to pay for excess horsepower. With LIGHTNINS, you have a *full range* of sizes to choose from —18 basic models, 1 to 25 HP.

Finally, you can order LIGHTNINS with the motor that gives you best service and minimizes your stock requirements: any make with NEMA frame; any current characteristics; any enclosure or insulation.

Get these 20-year savings—You don't pay more for this freedom of choice. You *save*—because you cut your mixer operating, maintenance, and parts-stocking cost for *as long as the next 20 years.*

Start planning *now* for long-term savings in your fluid mixing operations. For quick, competent help, just phone your LIGHTNIN Mixer representative (listed in Refinery Catalog). Or write us direct.

CUT MIXER MAINTENANCE as much as 60% with the new LIGHTNIN cartridge-type rotary seal, optional with LIGHTNIN Mixers. It positively stops leakage, runs for years without adjustment—and slides off the shaft for fast, easy replacement if ever necessary.

Lightnin® Mixers

MIXCO fluid mixing specialists

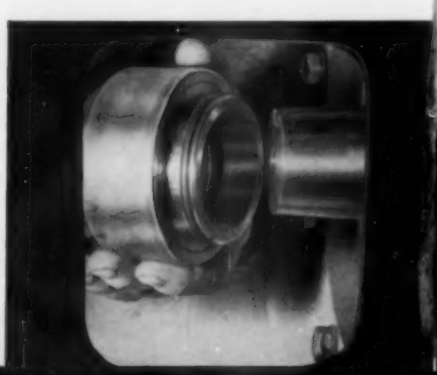
FOR LATEST MIXING INFORMATION and full description of LIGHTNIN Mixers, send for these helpful bulletins:

- ☐ B-102 Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP
- ☐ B-103 Top entering; propeller types: ¼ to 3 HP
- ☐ B-108 Portable: ½ to 3 HP
- ☐ B-104 Side entering: 1 to 25 HP
- ☐ B-112 Laboratory and small-batch production types
- ☐ B-109 Condensed catalog showing all types
- ☐ B-111 Quick-change rotary mechanical seals for pressure and vacuum mixing
- ☐ B-107 Data sheet for figuring mixer requirements

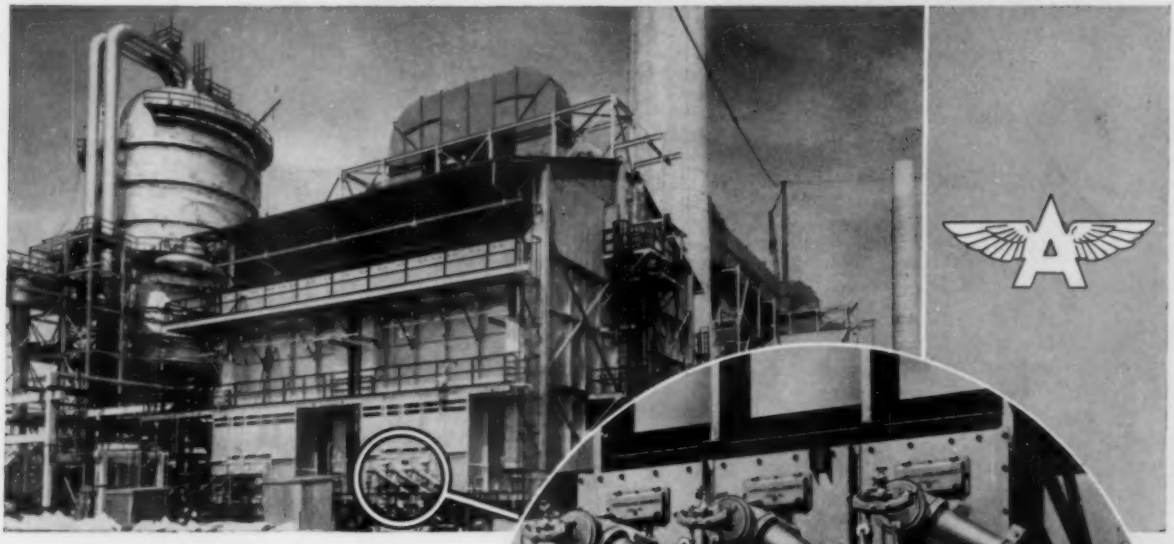
Check, clip, and mail with your name, title, company address to:

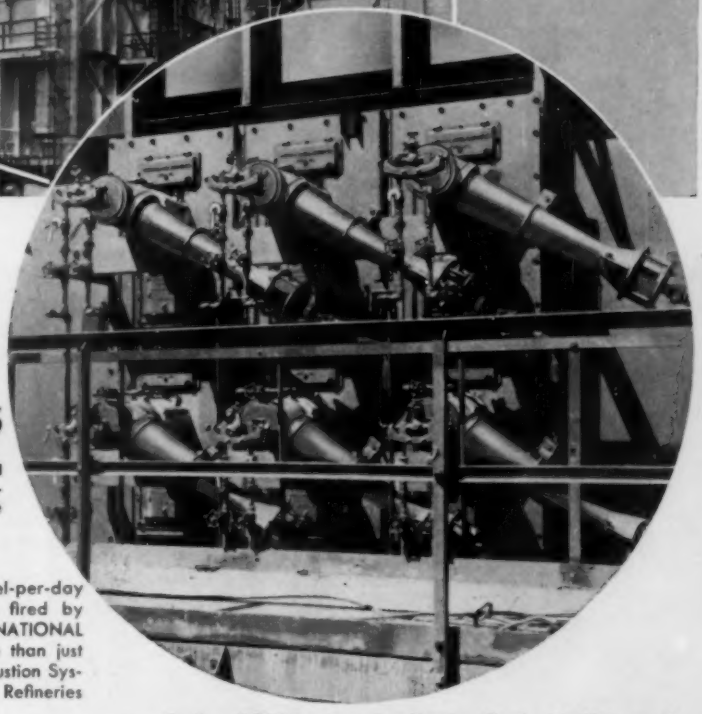
MIXING EQUIPMENT Co., Inc., 174-8 Mt. Read Blvd., Rochester 11, N.Y.

In Canada: Greey Mixing Equipment, Ltd., Toronto 10, Ont.



Firing CRUDE DISTILLATION UNIT HAVING WORLD'S HIGHEST THRUPUT...





NATIONAL AIROIL
OIL-GAS TANDEM COMBUSTION UNITS

Looming large in the effort to meet increased products demand on the petroleum industry is Tidewater Oil Company's ultra-modern Delaware Refinery, for which C. F. Braun & Co. were the engineers and constructors.

We are proud that this mammoth 130,000 barrel-per-day crude oil Foster Wheeler Corporation heater is fired by NATIONAL AIROIL BURNERS... Why?... because NATIONAL AIROIL "Hi-Visk Airocool" Tandem Units are *more* than just combustion equipment. They are an *exclusive* Combustion System which has proved dependable in Petroleum Refineries throughout the world.

"Hi-Visk Airocool" Tandem Combustion Units (firing refinery gases, liquid asphalt, refinery fuel oils) hold heated combustion air within the high temperature zone until fuels and air are thoroughly mixed. This means that combustion takes place under the best conditions; the result: increased fuel efficiency with a minimum of excess air.

NATIONAL AIROIL Tandem Units provide extra flame travel *without adding to the furnace depth*, eliminating flame inpingement on walls and tubes, extending the life of those elements; and because of this added flame length, the heat is more uniformly distributed.

The Tandem Unit is popularly fired with NATIONAL AIROIL Combination Oil and Gas Burners. YOU will realize higher profits from YOUR heaters when Tandem Combustion Units are specified. Further information sent upon request on your business letterhead.

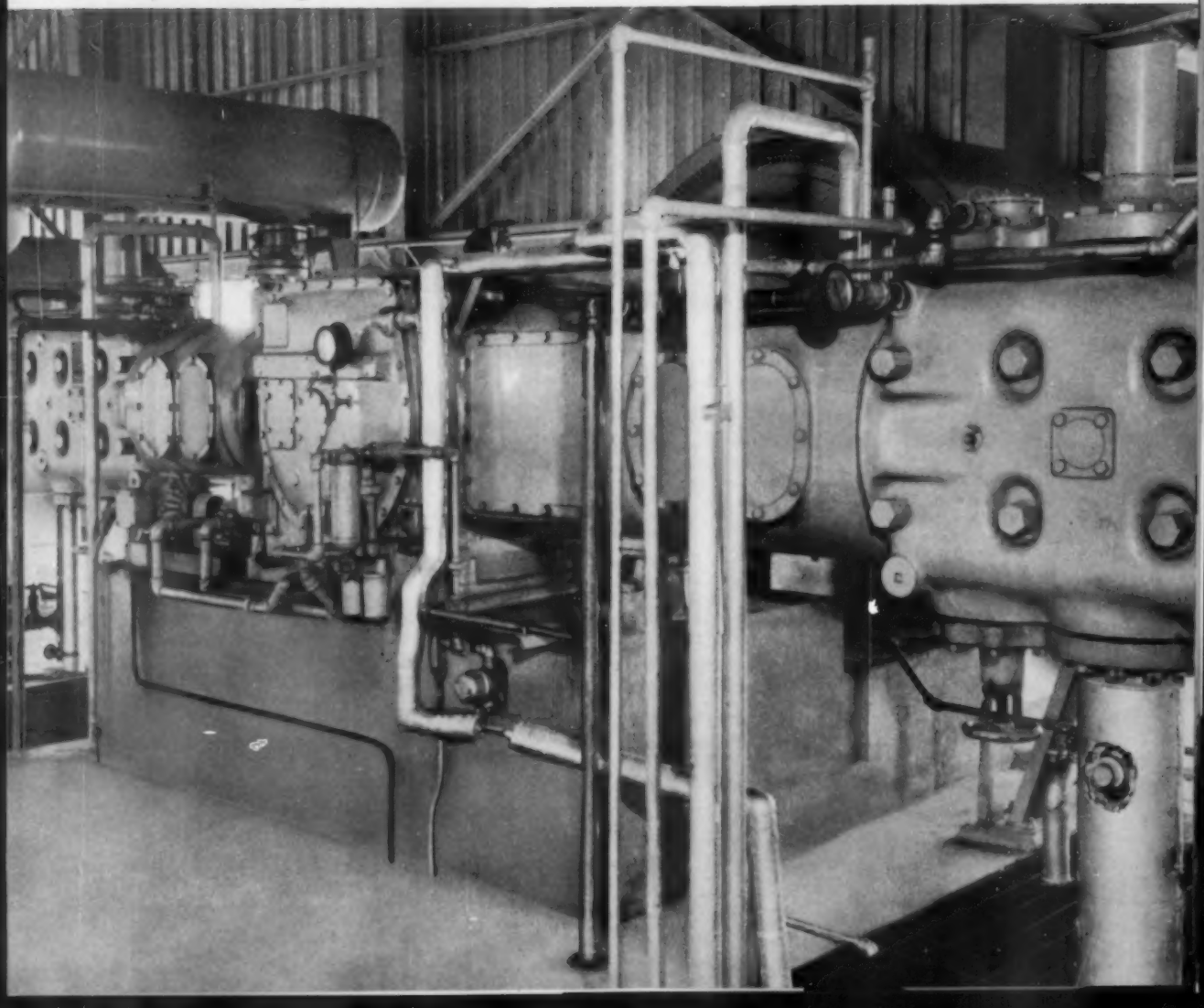
OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes: STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; AUTOMATIC OIL BURNERS, for small process furnaces and heating plants; GAS BURNERS; COMBINATION GAS and OIL BURNERS; FUEL OIL HEATERS; FUEL OIL PUMPING and HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

Main Office & Factory: **1236 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.**
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

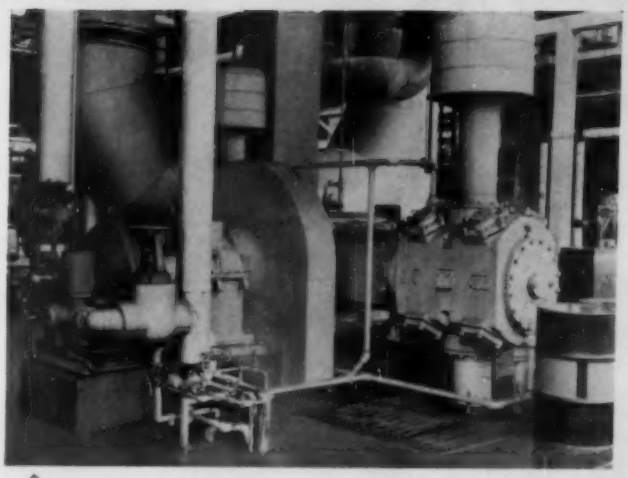
Cooper-Bessemer



▲1 This 2-cylinder FM compressor, steam turbine driven, supplies aeriation air for this new Tidewater installation.

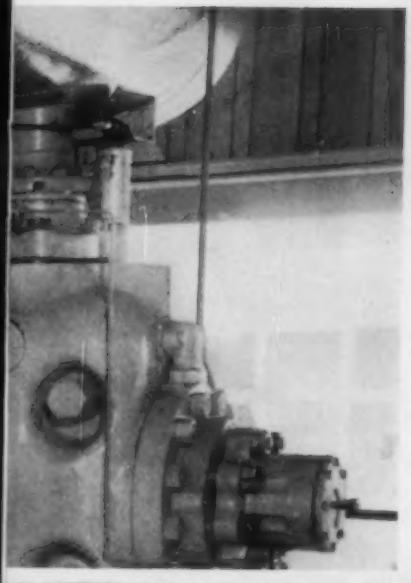
▲2 To maintain absolute purity in hydrogen compression, this compact motor-driven FM is equipped with non-lubricated cylinders.

▲3 Handling industrial air requirements for Tidewater's Delaware refinery . . . three 4-cylinder Cooper-Bessemer compressors,—one synchronous driven and two steam turbine driven.



▲1

FM Compressors



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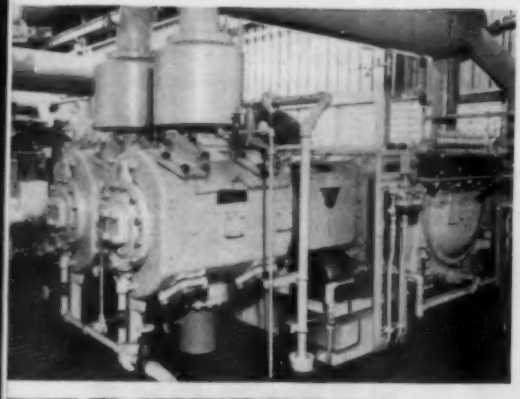


▲3

...for simplicity and efficiency in meeting multiple requirements in the world's largest refinery ever to be built at one time

In Tidewater's giant Delaware Flying A Refinery, Cooper-Bessemer FM compressors meet multiple service requirements with extreme efficiency and at the lowest possible cost.

Handling the compression of hydrogen and air these flexible units . . . motor and steam turbine driven . . . deliver the usual high standards of Cooper-Bessemer availability and performance. In addition, interchangeability of parts greatly reduces required inventories and keeps space requirements at a minimum.

Combining rugged strength and stamina with natural force balance, Cooper-Bessemer offers a compressor size and type to meet the most exacting needs. Write today for further information.

BRANCH OFFICES: Grove City • New York • Chicago • Washington • San Francisco • Los Angeles • Houston • Dallas • Odessa • Minneapolis • New Orleans • Shreveport • Casper

SUBSIDIARIES: Cooper-Bessemer of Canada, Limited . . . Edmonton • Calgary • Halifax
Cooper-Bessemer International Corporation . . . New York
Caracas • Havana • Mexico City

Cooper/Bessemer

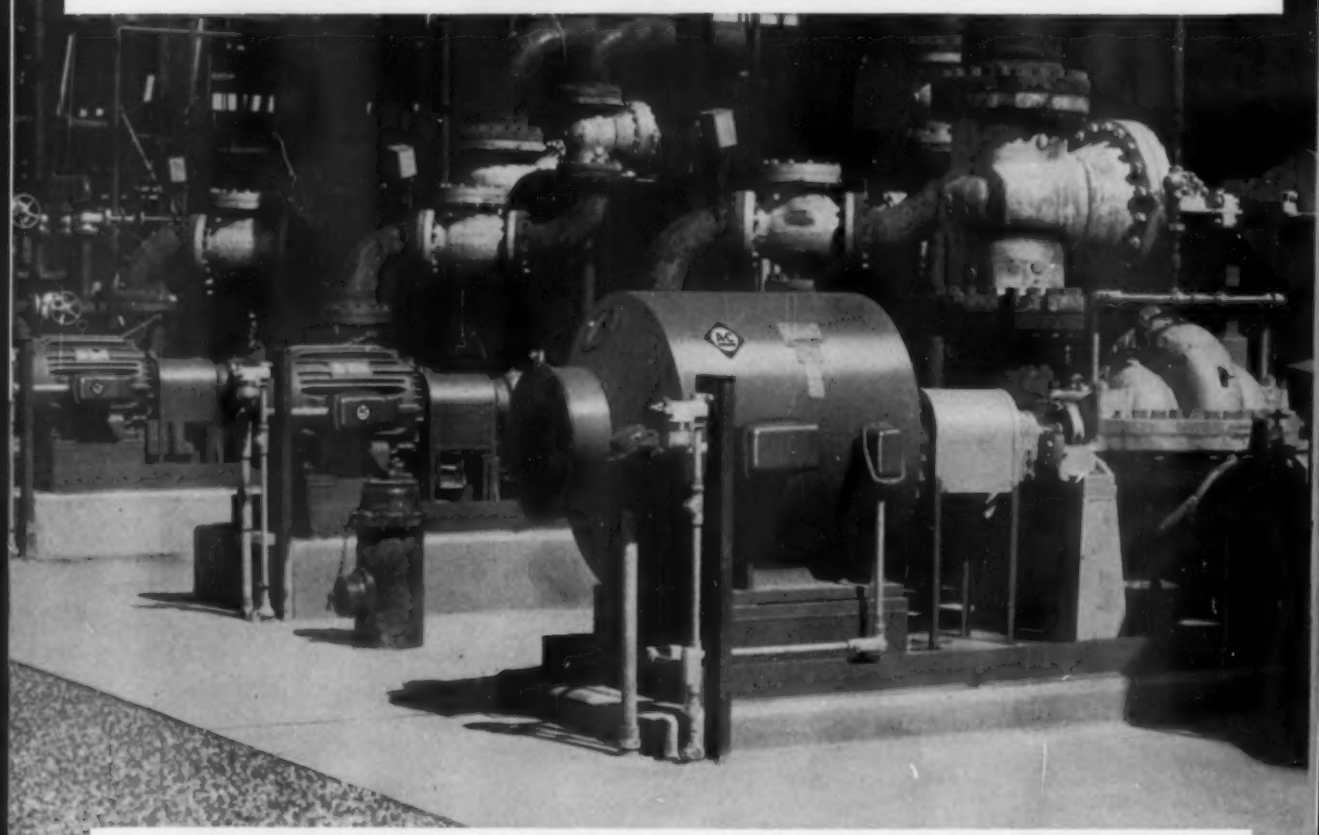
GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN

for more continuous processing—

Another great refinery installs

ALLIS-CHALMERS MOTORS



Thousands of horsepower in Allis-Chalmers motors will drive processing equipment at Tidewater Oil Company's new Flying A Refinery, near Delaware City, Delaware.

Designed and constructed by C. F. Braun & Co., engineers and constructors, this plant will process 130,000 bbl of crude oil per day. The largest ever built in a single construction operation, this huge refinery joins a growing list of major petroleum plants in which Allis-Chalmers equipment is used. Main reason for this trend:

Continuous Operation

● **Ribbed Construction** of smaller motors gives up to 43% more cooling surface when compared with ordinary motors. *Tube-Cooled* design in larger sizes permits free flow of air. BOTH designs result in fewer winding burnouts.

● **Motors** are of the chemical type, designed for use in refinery operations.

● **Stators** receive more than the usual dips and bakes. They get extra dips and bakes plus two coatings of red enamel to provide maximum electrical life.

* * *

FIND OUT MORE about Allis-Chalmers motors for the petroleum industry. Contact your nearby A-C sales office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5185

SPECIAL SECTION

THE

Power Plant

. . . 800,000 lb. per hour of 600-psig. steam and 40,000 kw. of electricity

THE Tidewater refinery will take, initially, as high as 800,000 lb. per hour* of 600-psig. steam and 40,000 kw. of electricity from the adjacent power station of Delaware Power & Light Co. which was designed and built by Braun. This makes possible short supply lines.

Primary fuel for the plant will be fluid coke produced in the refinery. This fuel, over 90 per cent carbon, burns with less than ½ per cent fly ash and has a heating value of better than 14,000 B.t.u. per lb. Compressed air blows the coke to elevated silos in the station through three 5-in. lines.

Fuel gas, preferentially, and residual fuel oil, secondarily, will serve as the supplemental fuel needed to bring the coke to ignition temperature and to maintain combustion. The boiler design is based on 10 per cent supplemental fuel but this may be reduced to 5 per cent. The coke is pulverized to a fineness of 80 per cent through 200 mesh. Each of the three boilers is equipped with three pulverizers.

Boilers . . . Two boilers will meet the normal full-load steam and power requirements of the refinery. The third insures against interruption of service. Two turbine-generators meet the power requirements of the refinery and power station auxiliaries. They are supplemented by a 69-kv. tie line with the Delaware Power & Light Co. system to prevent a power failure if either or both turbines go down.

The boilers are two-drum, water-wall-type, slag-bottom boilers. They generate a total of 1,500,000 lb. per hour of superheated steam at 1,300 psig. and 950° F.

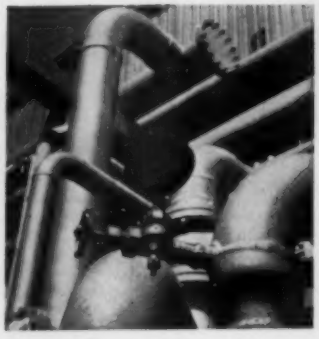
The two turbine generators are 25,000-kw., 3,600-r.p.m., extraction-condensing units. Normally each will deliver 20,000 kw. Bus duct, circuit

*Exclusive of more than 500,000 lb. per hour of steam generated in waste boilers in the refinery.

New Tidewater Delaware City Refinery

For the Outstanding Refinery of the Year
The Choice Was

JERGUSON INSTRUMENT VALVES and LIQUID LEVEL GAGES



New 66UVG Instrument Valves with Vertical Rising Ball Check

Jerguson Reflex Type Liquid Level Gages

For this magnificent new example of modern efficiency in refinery design and construction, the engineers chose Jerguson Instrument Piping Valves for their field mounted pressure gages, as well as Jerguson Liquid Level Gages and Valves. Throughout the plant you will find hundreds of dependable Jerguson Gages and Valves.

The new Jerguson 66UVG Instrument Valves are used in scores of places throughout the plant . . . the unique valves which have a vertical rising ball check and make it possible to eliminate the usual block valve. These valves speed construction and servicing because they combine the valve, unions, nipples, reducers, elbows, tees, valve and bleed valve in one package . . . a space saving unit with a great reduction in threaded connections.

Liquid level measurement throughout the refinery is handled efficiently by dependable Jerguson Liquid Level Gages and Valves.

You too will find you can rely on Jerguson Gages and Valves to serve your many needs, for new construction or replacement.

Ask for catalog sheets on Jerguson 66UVG Valves and Liquid Level Gages.

JERGUSON

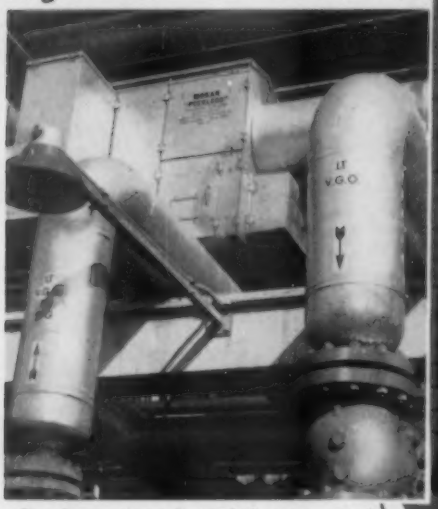
Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY

Offices in Major Cities **100 Adams Street, Burlington, Mass.**

Jerguson Tress Gage & Valve Co., Ltd., London, England, Pétrole Service, Paris, France

Regardless of the Weather in Delaware



One of many Moran Custom Built units, measured and designed on location, to winterize instruments within the space available.

TIDEWATER
will have
FULL
instrument
protection
against
RAIN
ICE
SNOW
SAND
DUST and
TEMPERATURE

MORAN "PEERLESS WEATHERPROOF" METER HOUSE

Expertly constructed of heavy gauge, galvanized sheet metal, Moran "Peerless Weatherproof" Meter Houses become a permanent warehouse for meters and other precision instruments, and their controls, valves and piping. Moran products are designed to meet the specific needs of its customers in oil production, refining, pipeline and petro-chemicals. The superiority of Moran products is the result of many years of experience in the field of instrument housing and protection.

The sound business principles which prompted the ordering of over 1000 specially designed Moran Instrument Houses for Tidewater's Delaware Refinery reflects the truth of Moran's 30-year slogan . . . "If it's worth recording . . . it's worth protecting" . . . protecting not only the instrument, but the *job* it is installed to do.

THE "PEERLESS WEATHERPROOF" PRINCIPLE OF PROTECTION

The principle behind the positive protection offered by all Moran equipment is simple, effective, and utilizes Nature's own unchanging laws . . . "Peerless Weatherproof" Meter Houses are *large enough* to use the air itself . . . the air *around* the enclosed instrument . . . as insulation against the *shock* of sudden atmospheric or temperature changes . . . heat, wind, rain, snow, dust. Such changes then become *gradual* and *equalized*, so that the instrument is not subjected *directly* to the elements. This simple principle has stood the rigorous tests of field and plant usage on Moran "Peerless Weatherproof" Meter Houses since 1926!

POSITIVE DRAFT CONTROL . . . A SPECIALTY

Designed for the control of all combustion air entering a heating unit and all exhaust gases leaving the unit, Moran Positive Draft Control systems are hailed by refinery, gasoline plant and compressor station operators throughout the industry as the positive answer to the hazards of wind in controlling exposed burners in the field. Increased efficiency and safety factors have thus improved the operation of heating units equipped with natural draft, induced draft, or forced draft, with or without automatic controls.

Portable
Safe
Durable
Economical

Write for Illustrated Catalog

MORAN

OFFICE AND FACTORY
807 E. 5th Place
Tulsa 20, Okla.
Phone CHerry 2-4104

FACTORY
28-36 North Hickory
Sapulpa, Okla.
Phone Tulsa CHerry 2-4104

breakers, and switchgear are arranged for the addition of another generator when circumstances require it.

Electric motors . . . There are almost 500 motors ranging from ¾ to 3,000 hp. in the refinery. They include three 3,000 hp., nine 2,000 hp., two 1,000 hp., and more than 400 from ¾ to 800 hp. Those of 125 hp. or smaller are operated on 440-volt power and all larger motors on 2,300 volt power.

Intensive studies indicated a doubt that synchronous motor drives could survive severe voltage dips. Because of this and since there are so many points where shutdowns could not be tolerated, it was decided to use squirrel-cage induction motors throughout the refinery.

Of special interest are the nine 2,000-hp., 600-r.p.m. vertical centrifugal pump motors in the cooling-water system. Their requirements alone are about one-third the total for the entire refinery. They are totally enclosed, fan-cooled motors and are among the largest totally enclosed motors in physical size ever built.

Power distribution . . . The refinery's initial requirements of 40,000 kw. are distributed through six 13.8-kv. switchgear buses from the power plant. Each has a main 1,200-amp. air circuit breaker and four or five feeder breakers. Twenty-seven underground 13.8-kv. cable feeders serve the substations and one overhead 13.8-kv. line, the water terminal.

Nine spot network substations will distribute about two-thirds of the power through the refinery. Each is rated 13,800 to 2,400 volts to supply the 2,300-volt motors. Each has two 5,000/6,250-kv. transformers.

Remainder of the power is distributed to fourteen 13,800 to 480-volt secondary selective load-center substations each with two 750-862-kva. transformers. There are also two radical-type 750-kva. substations and a number of 350-kva. and smaller transformers for supplying isolated outdoor 440-volt motor control and switch racks.

One of the advantages of the spot network substations, modified with normally closed tie breakers, is the elimination of automatic bus transfer. Another is that the motor load is normally supplied from two power-station switchgear buses through two transformers. In starting and simultaneously accelerating several large motors, the voltage of the system is affected less than if these motors were connected to a single transformer.

Because of the high degree of reliability expected from the spot network substation power distribution

KONTOL
fights corrosion
at TIDEWATER DELAWARE REFINERY

Tidewater Oil Company's all-new Delaware Refinery has spared no detail to assure the very latest and the most efficient in refinery processing equipment.

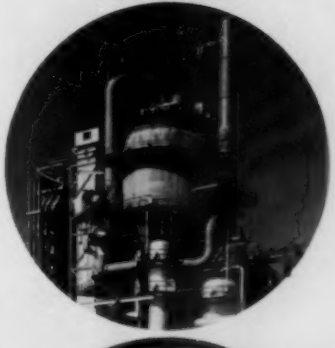
Significant, then, is their choice of Tretolite's KONTOL CORROSION INHIBITORS for the economical protection of this equipment against a costly variety of corrosive and related problems.

These Kontol Products are on the job at the Refinery in three important places: on the crude unit, the cat cracker and in the coking unit.

In addition to their corrosion inhibiting properties, these same Kontol Products are protecting the equipment against fouling, because of their powerful detergent effect.

CAT CRACKER...

CRUDE UNIT...



COKING UNIT*...

TRETOLITE COMPANY
A DIVISION OF PETROLITE CORPORATION

369 Marshall Ave., St. Louis 19, Mo.
5515 Telegraph Rd., Los Angeles 22, Calif.

Chemicals and Services for the Petroleum Industry

DEMULSIFYING • DESALTING • CORROSION PREVENTION • WATER DE-OILING
PARAFFIN REMOVAL • SCALE PREVENTION

ALL BEING PROTECTED BY

KONTOL
CORROSION INHIBITORS

For more information on these same KONTOL products . . . see
THE MAN IN THE TRETOLITE CAR

**Photo Courtesy C. F. BRAUN & CO. Engineers and Constructors Alhambra, California*

TT-57-1

ECONOMICAL FROM EVERY ANGLE

'AMERICAN' "Every Angle" THERMOMETERS

No longer is it necessary to fuss and figure what angles of stem connection are required in thermometers for each location. These American "Every Angle" Dial Thermometers can be set at any angle within 180° on *two* axes – set at the best angle for easiest reading.

Regardless of what piping arrangements are engineered into your processes – no matter how many times they are revised – the list of American "Every Angle" Thermometers in your original specifications need not be changed. Equally important, your thermometer inventory in all required temperature ranges and stem lengths will be far smaller. That's real economy – from every angle.

Bi-metal . . . mercury . . . vapor pressure – all three types of actuation are available in American "Every Angle" Dial Thermometers. They are precision instruments that assure accuracy within 1% of scale range. Their high accuracy is sustained throughout service life, whether installed indoors or outdoors.

Make full use of these highly sensitive thermometers at all important check points in your plant. You will maintain product quality far better than ever before. Your field operators will be able to take readings more easily, more accurately, more frequently – will save time-stealing trips to the control house. Convince yourself of the all-around economy of American "Every Angle" Dial Thermometers. Write for complete information.

BI-METAL ACTUATED, TYPE 6060AH. 5" Anti-Parallax Maxivision Dial. **Temperature Ranges:** –80/120 F. to +200/1000° F. **Stem Lengths:** 4" to 24". Climate-proof stainless steel case.

MERCURY ACTUATED, TYPE 6042RM. 4½" Anti-Parallax Maxivision Dial. **Temperature Ranges:** –20/120° F. to 200/1000° F. **Stem Lengths:** 4" to 24". Climate-proof glass and stainless steel case.

VAPOR PRESSURE ACTUATED, TYPE 6040TW. 3½" Dial. **Temperature Ranges:**–20/120° F. to 260/450° F. **Stem Lengths:** 3" to 24". Models for indoor or outdoor service.

Separable sockets can be supplied in all materials and sizes normally required.

SET-ABILITY THAT MEANS FLEXIBILITY IN APPLICATION

SET IT for use as a side angle, 90°, oblique or top connection thermometer.

SET IT for use as a straight-form thermometer.

SET IT for use as an oblique-form thermometer.

SET IT for use as a standard 90° back-connected thermometer.

CALL ON YOUR INDUSTRIAL SUPPLY DISTRIBUTOR for experienced counsel in dial thermometer selection. You can depend on him for prompt delivery from local stocks.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn., and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

system, emergency steam drives have been kept to a minimum. Turbine drives are used for spare pumps and compressors that must be kept operating in an emergency to insure safe shutdown. But the need for maintaining a very large supply of steam throughout the refinery for emergency use only is removed.

1,500 Pieces of Equipment Handle Refinery Processes

TIDEWATER'S Delaware refinery uses the most modern methods available for handling almost every kind of material that will flow through pipe. Among them are crude oil, intermediate products, hot vapors, gasolines, kerosines, oils, sludges, steam, air, refrigerants, water, brine, corrosive chemicals of many kinds, and fluidized solids. They are handled at many levels of pressure and temperature and in quantities from cubic centimeters per hour to tons per minute.

Vast amounts of material and labor went into the construction of the facilities to handle these fluids and semi-fluids. There are 1,000 miles of pipe, including 30,000 fabricated pipe spools. The 100,000 valves range from ¼ in. to 8 ft. in diameter.

Power flows through 400 miles of underground and overhead lines. Refining processes go on in 1,500 principal pieces of equipment. Over 9,000 field workers and some $6,000,000 worth of construction equipment were employed by C. F. Braun & Co., engineers and constructors, at the peak of the project.

Refinery Pipeway Has 36-In. Blowdown Header

LARGEST of the lines in the main pipeway of Tidewater's new refinery at Delaware City, Del., is the 36-in. on blowdown header. It terminates in flare stacks at either end. All volatile gases are vented into the header through safety valves.

Expansion joints are spaced at regular intervals along the blowdown header. This is to accommodate some of the very hot gases the line will be called upon to handle. The pipeway is especially designed to withstand the header's extremely high thrusts.

Temporary Pipe Shop Set Up During Construction Work

WHILE Tidewater's new refinery was under construction, a completely staffed and modern field pipe shop was set up. It had the largest capacity

For the DELAWARE REFINERY . . . effective fire protection with this fleet of NATIONAL FOAM vehicles

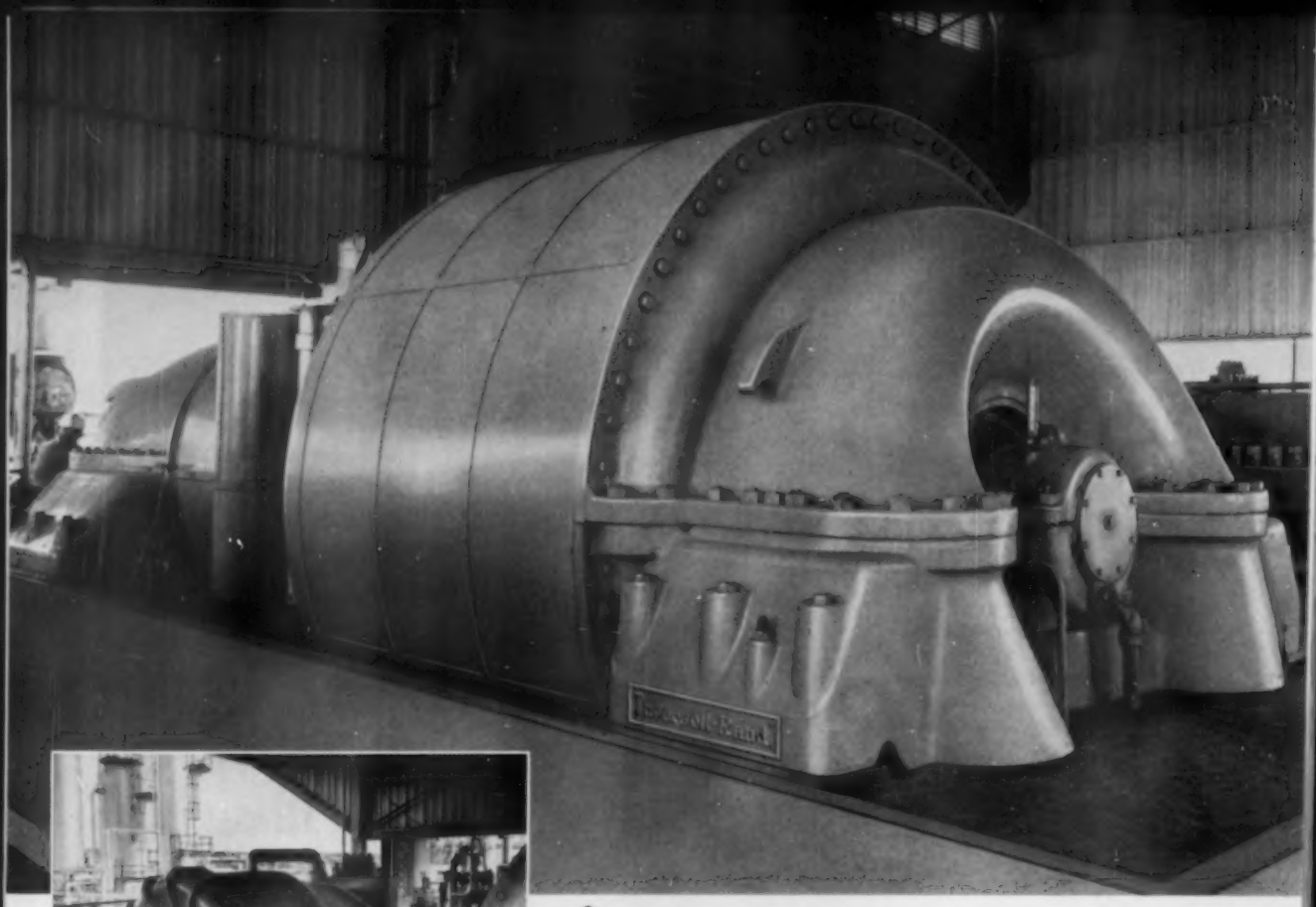
Two Aer-O-Flow trucks, two tank trailers, two hose trailers and a proportioning trailer are included in the mobile equipment that guards against fire in America's newest refinery. Built by National Foam, these vehicles join with fixed equipment . . . National Aer-O-Foam Chambers, National Aer-O-Foam Towers, and National Aer-O-Foam Floor Nozzles . . . to provide area-by-area protection, night and day, throughout Tidewater Oil Company's new Delaware plant.

Safety executives: write for current issue of National Foam's "Foam Facts," with full information and picture-story on fire-fighting equipment at the new Delaware Refinery.

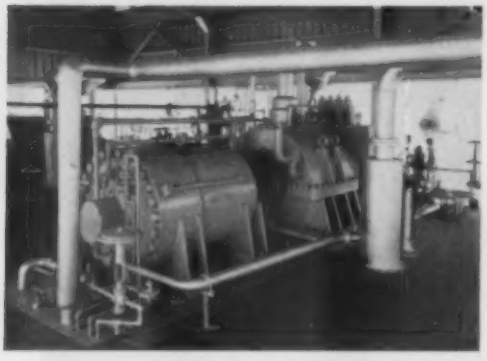
NATIONAL FOAM System, Inc.
West Chester, Pa.

NATIONAL FOAM SYSTEM FOR PROTECTION

The only company exclusively engaged in the design, development and manufacture of foam fire protection equipment and chemicals.

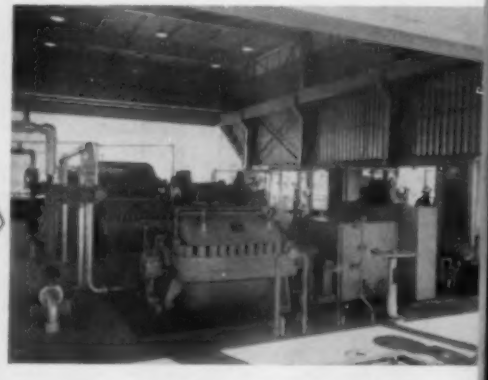


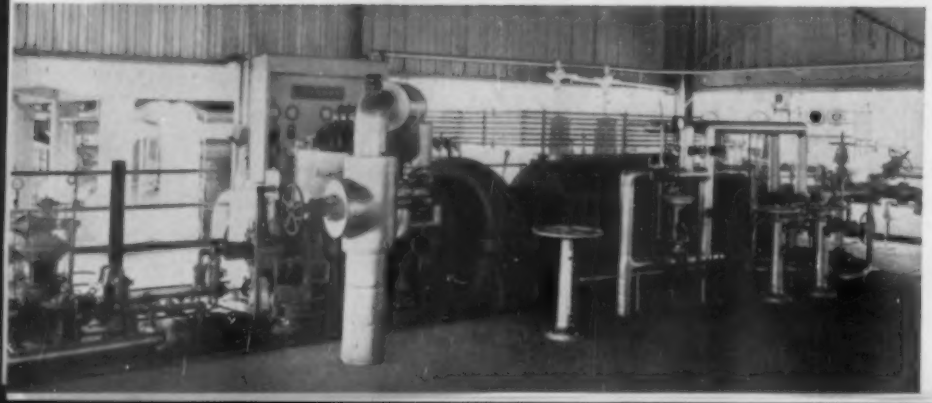
ORTHOFLOW CRACKER, the largest cat cracker ever built, is served by this huge I-R Turbo-Blower — a 161,500 cfm unit that discharges at 30 psia. It is the largest cat-cracking air blower in the world and is driven by an I-R 11,250-hp steam turbine. The 3000-hp I-R centrifugal shown at left serves as the carrier or fluidizing compressor on the cracking unit.



HOUDRIFORMER
Two I-R steam-turbine-driven barrel-type centrifugal compressors recycle hydrogen gas. Each unit is rated 5050 cfm at 675 psia discharge pressure.

GAS PLANT uses two I-R centrifugals to transfer hydrocarbon gases from the cracker. Operating in parallel, each is rated 15,500 cfm, 200 psia discharge and each is driven by an I-R steam turbine.





FLUID COKER, also the world's largest, is served by three Ingersoll-Rand Centrifugals — each driven by an I-R steam turbine. The main air blower, rated at 109,200 cfm at 29 psia is equipped with I-R adjustable inlet guide vanes to permit full-pressure operation down to approximately 30% rated capacity. At the left is one of the two tandem I-R centrifugals that serve as transfer gas compressors. Each is rated 16,100 cfm at 230 psia.

More than 65,000 hp of I-R Compressors serve

TIDEWATER
DELAWARE REFINERY

Nineteen Ingersoll-Rand compressors, representing more than 65,000 horsepower, will help the Tidewater Oil Company process 130,000 barrels of oil daily at its new Delaware Refinery south of Wilmington. The refinery is the largest ever built at one time. C. F. Braun & Co. were the engineers and constructors of the huge project which includes several processing units that are the largest of their kind.

The I-R compressors — *both centrifugal and reciprocating units* — will handle a variety of gases for the processing units. Each of the nine centrifugals is driven by an Ingersoll-Rand steam turbine. The reciprocating compressors are electric-motor-driven.

Other Ingersoll-Rand equipment used in the refinery includes ejectors and centrifugal pumps. In the general construction of the refinery, I-R tools and portable compressors were used extensively.

This outstanding installation is further evidence of Ingersoll-Rand's ability to design and build air and gas compressors that best meet the most exacting processing requirements of capacity, pressure, dependability and ease of maintenance. An I-R engineer will be glad to give you complete information on a compressor best suited to your needs.

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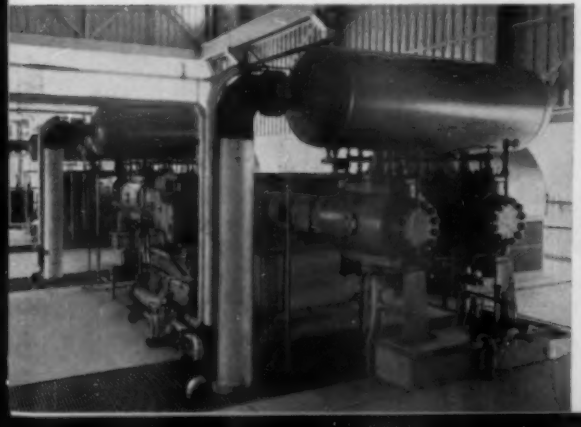
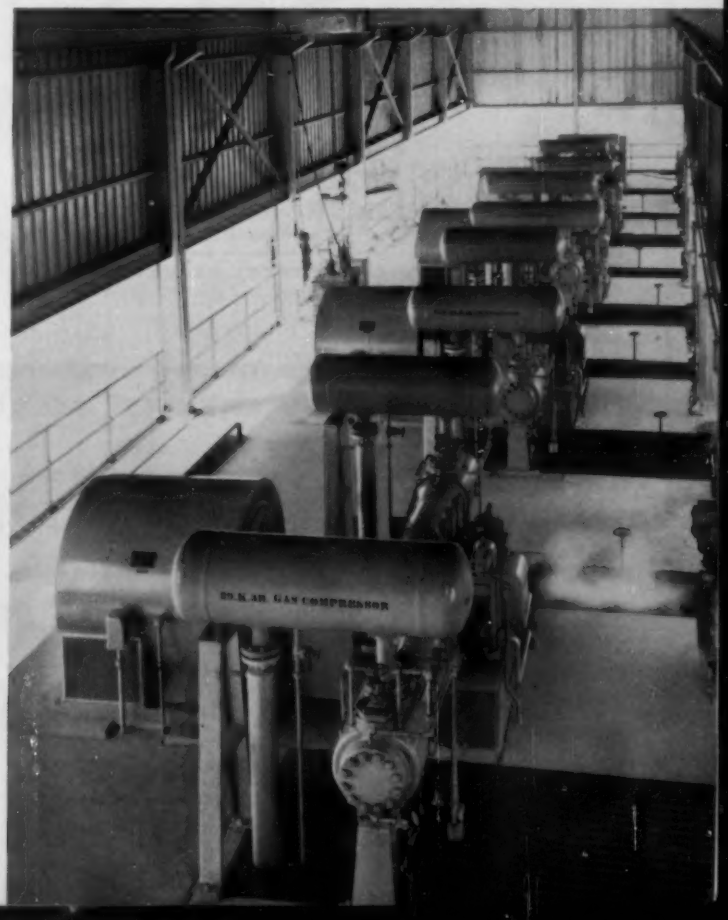
HYDROGEN PLANT—Three Ingersoll-Rand 3000-hp HHE reciprocating compressors (not shown) serve the hydrogen plant which produces 30,000,000 cubic feet per day of make-up hydrogen used in the reformer and desulphurization units. Each compressor has a capacity of 2,280 cfm.

DESULPHURIZATION UNIT

For circulating hydrogen gas in the desulphurization unit six Ingersoll-Rand HHE compressors are used. The two 800-hp units, shown below, have non-lubricated cylinders. An Ingersoll-Rand ES Compressor serves as a recovery compressor.





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of any such shop in the world during its brief life span. The shop was used to fabricate pipe spools that were larger and more complete than those normally carried by common carriers.

More than 24,000 carbon-steel pipe spools, up to 10 ft. in diameter, were turned out in this shop. The average exceeded 800 per week from a single shift at peak production.

The bulk of the piping is carbon steel but the refinery uses almost every known pipe material: low chrome alloys, stainless steel and monel, alloy clad lines, cement-lined breechings, lines with refractory linings, lines of copper and its alloys, nickel and its alloys, plastic, etc.

Main Pipeway Is 1 Mile Long and 40 Ft. Wide

THE main pipeway of Tidewater's Delaware refinery is approximately a mile long and 40 ft. wide. Its three decks carry 50 miles of pipe up to 36 in. in diameter which ties in all of the processes.

En route to storage tanks, crude oil or partly processed products will have passed through almost 250 miles of piping. Included in the pipe fabricating job are more than 1,500 tons of fabricated alloy. Some 1,400 separate pieces, averaging more than a ton apiece in weight and needing more than 20,000 blueprints, were fabricated. Their wall thicknesses ranged up to 1½ in. and their diameters up to 20 in.

Cooling Water Delivered at 275,000 G.p.m. from River

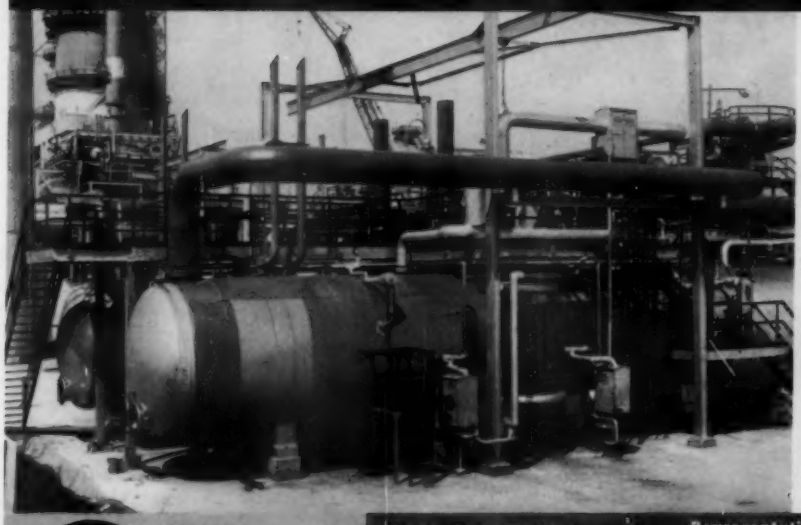
TIDEWATER'S new refinery gets its cooling water from the Delaware River. The refinery is situated on high ground, about 50 ft. above the river, and about 1½ miles from it. The water is lifted this height and carried this distance by eight 2,000-hp. pumps which deliver it to the refinery at the rate of 275,000 g.p.m.

Since the river water is brackish, the pumps have internal parts of stainless steel to protect against corrosion. They discharge into two 78-in. reinforced concrete conduits at a pressure of 80 psig. Two surge tanks, 20 ft. in diameter and 80 ft. in height, protect system against water-hammer damage.

Delaware River Supplies Water for Cooling System

USED cooling water from Tidewater's Delaware refinery is returned to the Delaware River through two 80-in. gravity culverts. In order to

TWIN GIANT FURNACES
BUILT BY BIGELOW FOR TIDEWATER



These Sulphur Recovery Reaction Furnaces shown installed at Tidewater Oil Company's refinery at Delaware City, Delaware were built by Bigelow.

Each weighs 82 tons, is 10'6" in diameter and 65' long. They were designed by the Ralph M. Parsons Company for C. F. Braun & Co.

They are two outstanding example's of Bigelow's ability in steel vessel fabrication. This ability stems from Bigelow's more than a century of experience in building water-tube and fire-tube boilers.

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BJ-10

"All I can say is—you'd better be at your desks at stroke of nine."

Congratulations

TO

Tidewater Oil Company & C. F. Braun, Contractors

on

Constructing World's Largest Refinery

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GRAY CONCRETE PIPE COMPANY, INC.

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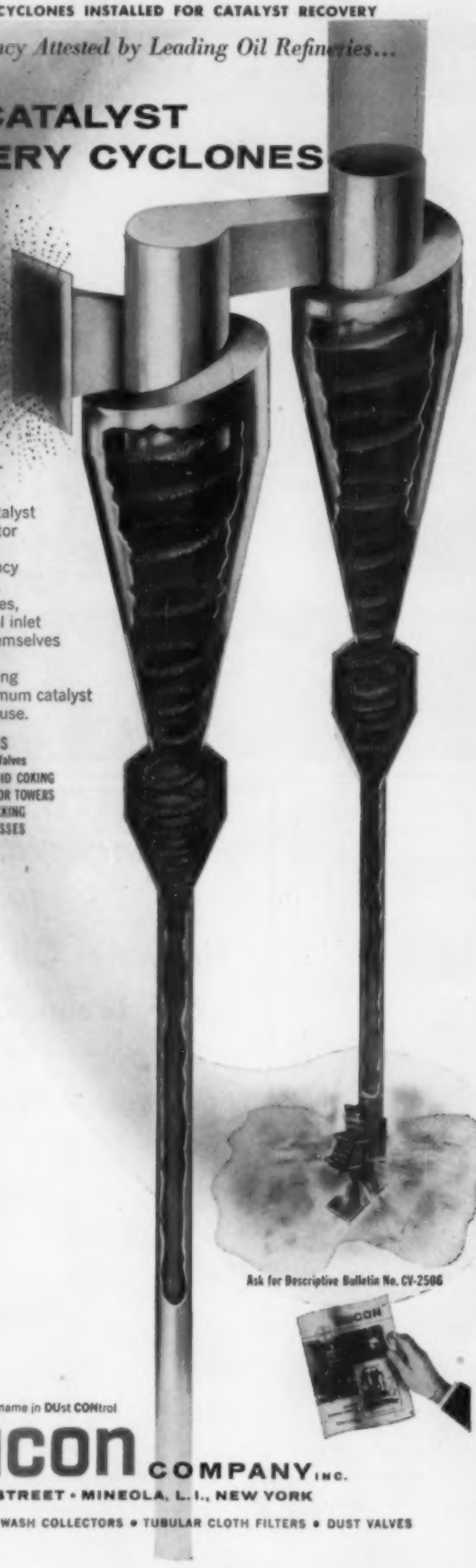
EXCLUSIVE WITH TIDEWATER DELAWARE CITY REFINERY—
141 DUCON CYCLONES INSTALLED FOR CATALYST RECOVERY

High Efficiency Attested by Leading Oil Refineries...

DUCON CATALYST RECOVERY CYCLONES



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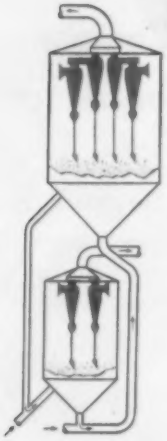

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prevent excessive velocity in the concrete pipe, due to the rapid drop in elevation, the energy of the water is dissipated in large square concrete shafts, known as drop structures. The water falls vertically in these and expends its energy in turbulence.

Closed culverts discharge the water into a system of open channels through which the water flows to the river. The cooling-water system was one of the first parts of the plant to go into operation. It was started up with the first units that went on stream early in the fall of 1956.

Various Alloys Are Used For Refinery Requirements

OPERATIONAL requirements of Tidewater's new refinery cover a vast range; temperatures up to 1,450° F. and pressures up to 900 psig. In the power plant, operating characteristics are 1,350 psig. and 950° F.

Different alloys were fabricated to meet such requirements: carbon-moly, 1 per cent chrome, 1¼ per cent chrome, 4-6 per cent chrome, 6-8 per cent chrome, 8-10 per cent chrome, inconel, monel, incoloy, 99 per cent nickel, Type 304 stainless steel, Type 316 stainless steel, Type 310 stainless steel, aluminum alloys, and others.

Alloy piping projects required in excess of 10,000 welds. Specifications for the job required 100 per cent penetration for all welds without the use of backing rings.

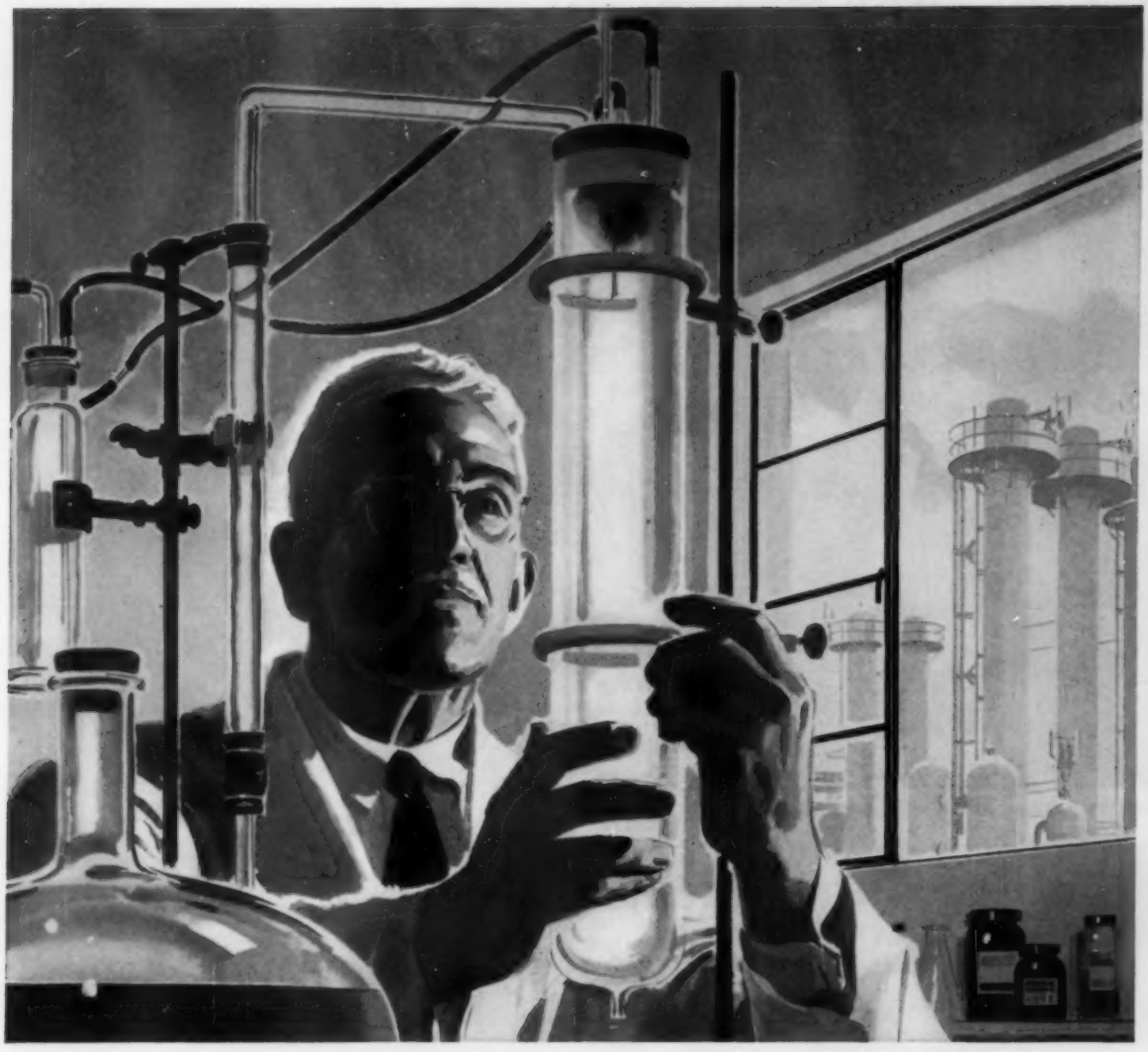
An inert-gas nonconsumable electrode process was used to accomplish this. All butt welds were radiographed and nozzle welds and coupling welds were either magnetic-particle inspected or checked with penetrant dye.

Fluid Coke Is Airveyed To Central Power Station

THE 500-ft. concrete stack serving the power station of Delaware Power & Light Co. plant is reported to be the highest structure in the State of Delaware. The plant is adjacent to and supplies power and steam for Tidewater's new Delaware refinery.

It is the first central power station designed to operate on fluid coke. The coke is airveyed to the power plant after being cooled at the coker and fluidized by aeration. The airveyer lines have long sweeping bends and smooth transitions to minimize erosion.

The pipeway is at the end of the refinery's main pipeway and the airveyer lines use it. In it they parallel the 20 and 24-in. main steam headers that carry 540,000 lb. per hour of 600-psig. steam to the process area.



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Construction men fought terrain and bitter cold in the construction of PNW's "scenic-inch" pipeline.

Why communications have to be good on Pacific Northwest's "scenic-inch" line

Pumping gas over mountain passes across 1487 miles of America's toughest terrain requires the most reliable communications available.

Pacific Northwest Pipeline Corp. presented this requirement to the Bell System, with one additional request—economy.

The result is a private line telephone system that PNW's Salt Lake City control center uses to keep a running summary of conditions along the line. Information gathered in Salt Lake City from each compressor station includes dew point, BTU content and specific gravity of the gas. Dispatchers use this data as guidance in controlling flow.

• • •

Bell System communications can work for you as fast and reliably. Just call your Bell Telephone Company business office. A representative will gladly discuss your requirements.

Pacific Northwest's Salt Lake City dispatchers collect data hourly from every compressor station and maintenance point on the company's 1487-mile pipeline.

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Pipeline Patrol

. . . Report on Construction

PIPELINE activity reported here is compiled from surveys conducted by The Oil and Gas Journal among pipeline companies and contracting firms. Projects listed include those proposed, contracted, and under way.

U.S. Crude-Oil Pipelines

- **Cape Pipe Line Co.** (organized by Sun Oil Co., Cities Service Co., Atlantic Refining Co.)

  Project: Long range plans for line on the lower Delaware Bay to the Philadelphia refining area.

  Completion: 1960.

- **Cosden Petroleum Corp., Onyx Div.**

  Project: 37 miles of 4, 6-in. main line plus 15 miles of laterals in central and southern Taylor County, West Central Texas, to deliver to Onyx plant at Hawley, Tex.

  Status: To start when weather permits.

  Completion: July 1, 1957.

- **Four-Corners Pipe Line Co.** (newly formed by Shell Oil Co., Standard Oil Co. of California, Continental Pipe Line Co., Gulf Oil Corp., Richfield Oil Corp., Superior Oil Co.)

  Project: 600 miles of line from near Farmington, N. Mex., in the Four Corners area to Los Angeles, to be constructed and operated by Shell Pipe Line Corp. as agent for the companies.

  Status: Under way.

  Completion: End 1957.

- **Fulton, R. H. & Co.,** Lubbock, Tex.

  Project: 39 miles of 6-in. from Donkey Creek field in northeastern Wyoming, southeast to the Osage pump station in Weston County.

  Status: Fulton, a contractor has applied to Wyoming Public Service Commission.

- **Great Northern Railway Co.**

  Project: 400 to 600 miles of 12 to 20-in. from Williston basin in Montana and North Dakota, to Clearbrook or St. Paul, Minn.

  Status: Under study.

  Contractor: **Pipe Line Technologists, Inc.** has contract for feasibility study.

- **Interstate Oil Pipe Line Co.**

  Project: 5 miles of 4-in. from South Bosco field, Louisiana, to present main line, and 5 miles of various size from Church Point field, Louisiana, to present main line.

  Status: Proposed.

- **Magnolia Petroleum Co.**

  Project: 203 miles of 12, 16, and 20-in. loops between Midland and Beaumont, Tex.

  Status: To start August 1957.

  Contractor: **O. R. Burden Construction Corp.** has 121 miles of 16-in. and 5 miles of 12-in. between Midland and Corsicana. **H. B. Zachry Co.** has 77 miles of 12, 16, and 20-in. between Corsicana and Beaumont.

  Completion: Early 1958.

- **Muskegon Pipe Line Corp.** (newly formed by Aurora Gasoline Co. and Service Pipe Line Co.)

  Project: 165 miles of 10-in. from Griffith, Ind., to Muskegon, Mich.

  Status: Planned.

  Completion: Late 1957.

- **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)

  Project 80 miles of 8-in. and 300 miles of 10-in. crude and products line from Four Corners area to Salt Lake City.

  Status: Proposed.

- **Offshore Gathering Corp., Houston.**

  Project: 364 miles of mostly 20-in. in Gulf of Mexico off Louisiana. (Dual line.)

  Status: Proposed.

- **Pasotex Pipe Line Co.**

  Project: 58 miles of 20-in. between Wink and El Paso, Tex.

  Status: To start in June.

  Contractor: **R. H. Fulton & Co.**

  Completion: September 1, 1957.

- **Salt Lake Pipe Line Co.**

  Project: 100 miles of 10-in. looping of Rangely, Colo., to Salt Lake City line.

  Status: Pipe has been ordered.

  Completion: Late 1957.

- **Shamrock Oil & Gas Corp.**

  Project: 35 miles of 6-in. to serve fields in Ochiltree and Hansford counties in the Texas Panhandle.

  Status: Under way.

- **Shell Oil Co.**

  Project: Undetermined length of 3, 4-in. in South Louisiana.

  Status: Under way.

  Contractor: **Brown & Root, Inc., W. P. Stanley,** spread superintendent, office at Buras, La.

  Completion: September 30, 1957.

- **Sinclair Pipeline Co.**

  Project: 150 miles of 20-in. from Teague, Tex., to Houston.

  Status: Planned for 1958.

  Completion: 1958.

- **Skelly Oil Co.**

  Project: 38 miles of 8-in. extension of its gathering system into southern Kiowa County, Kansas.

  Status: Planned.

  Completion: Early fall 1957.

- **Southern Kansas Pipeline, Inc.** (newly organized).

  Project: 200 miles of 6 to 10-in. from southwestern Meade County to a point in Cowley County, 10 miles north of Arkansas City.

  Status: Proposed. Request filed with Kansas Corporation Commission for permit.

- **Tecumseh Pipe Line System** (Joint venture of Sinclair Pipe Line, Ashland Oil & Refining, and Pure Oil Co.)

  Project: 201 miles of 20-in. between Griffith, Ind., and Cygnet, Ohio.

  Status: Under way.

  Contractor: **O. R. Burden Construction Corp.** has two spreads of 93 miles from Griffith eastward and 92 miles from the mid-point to Cygnet. The 16 miles from Chicago to Griffith has not been let.

  Completion: September 1957.

- **Texas-New Mexico Pipe Line Co.** (owned by The Texas Co., Sinclair Pipe Line Co., Tidewater Oil Co., and Empire Gas & Fuel Co.)

  Project: 515 miles of 16-in. from southeast corner of Utah to Jal in southeastern New Mexico.

  Status: To start late 1957.

  Contractor: Survey contracts went to **J. V. McCoy,** Houston, and **E. H. Schmidt and Associates,** Tulsa.

  Completion: 1958.

U.S. Products Pipelines

- **Alaska-Yukon Refiners & Distributors, Ltd.**

  Project: Two lines: one 150 miles from Haines to Haines Junction, Alaska, linking

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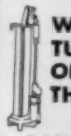

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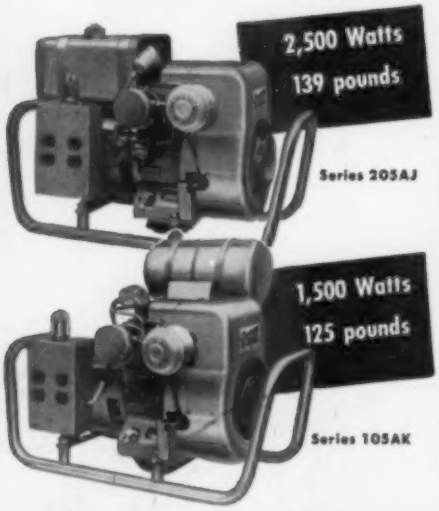

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Pipeline Patrol

with government Canol line; another from Tok Junction, on the Canol line, to Anchorage.

Status: Proposed.

Completion: 1959.

• **American Pipe Line Co.**

Project: Line from Gulf Coast to New York City area. Received ODM approval to amortize 40 per cent of $175,000,000 cost with a rapid writeoff.

Status: Proposed.

• **Buckeye Pipe Line Co.**

Project: Conversion of 116 miles of 8-in. crude to products between Huntington, Ind., and Griffith, Ind.

Status: under way.

Contractor: **Sheehan Pipe Line Construction Co.**, C. M. Brown, superintendent, office at Rochester, Ind.

Completion: Fall 1957.

Project: Conversion of 32 miles of 8-in. crude to products between Mantua, Ohio, and Youngstown area.

Status: Planned.

Contractor: Company will do own work.

Completion: November 1957.

Project: 70 miles of 8-in. from Wayne to vicinity of Durand, Mich.

Status: Pipe ordered.

Completion: Early 1958.

• **Cities Service Pipe Line Co.**

Project: 29 miles of 6-in. ethylene line from Lake Charles, La., to Orange, Tex.

Status: Planned.

Completion: July 31, 1957.

Project: 168 miles of 6-in. L.P.G. line from East Chicago, Ind., to Lowell, Mich.

Status: To start June 1, 1957.

• **Continental Pipe Line Co.**

Project: Conversion of 99 miles of 6-in. from the Wichita Falls area to near Fort Worth, Tex., plus a 15-mile extension of the line to the Grapevine area northeast of Fort Worth.

Status: Conversion under way. Extension planned.

• **El Paso Natural Gas Co.**

Project: 11 miles of 4-in. L.P.G. products from Snyder Line to South Andrews Plant, Texas.

Status: Planned.

Project: 240 miles of 6-in. from Odessa to El, Paso, Tex.

Status: Planned.

Contractor: **Pipeline Engineering Co.** has design and engineering contract. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contracts.

Completion: Early 1958.

• **Engineering Management, Inc.**

Project: 58 miles of 10-in. from Richmond to Castle, Calif.

Status: Under way.

Contractor: **Hood Construction Co.**, William Burgess, spread superintendent, office at Sacramento.

Completion: July 1, 1957.

• **Great Lakes Pipe Line Co.**

Project: 84 miles of 8-in. from south of St. Paul to Eau Claire, Wis.; 68 miles of 12-in. from Great Lakes intersecting point with Badger Pipe Line to Chicago.

Status: Construction scheduled to start spring 1957.

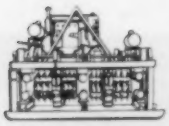
Project: 15 miles of 6-in. from Lincoln, Neb., to Lincoln air base.

Project: 140 miles of 8-in. from Minneapolis to Superior terminals.

Project: 34 miles of 12-in. from Tulsa to Barnsdall, Okla., to supplement existing 12 and 8-in. lines.

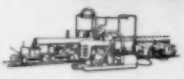
Project: 14 miles of 8-in. from Coffeyville to Independence, Kan., to replace present 4-in line.

Project: 11 miles of 8-in. from approxi-

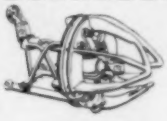

stationary cleaning & priming machine

line traveling coating & wrapping machine

pipeline cradles

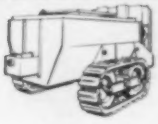

stationary coating & wrapping machine

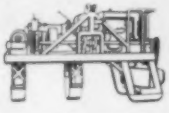
ditch padder

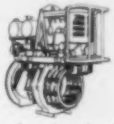

internal line up clamp

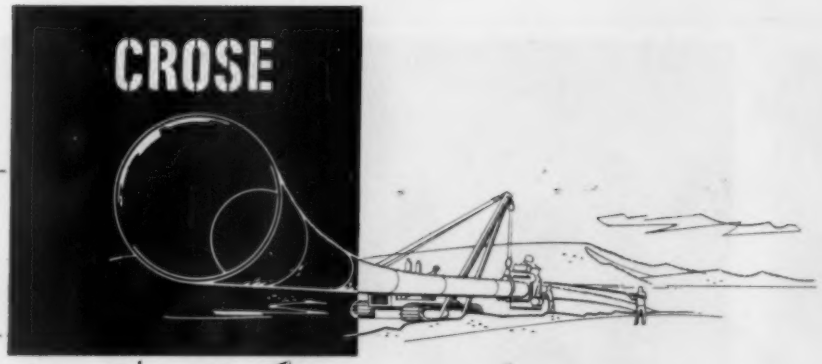
pipe cutting & beveling machine

Cinch hydraulic pipe bending machine


pipeline kettles


road boring machine


line traveling cleaning & priming machine



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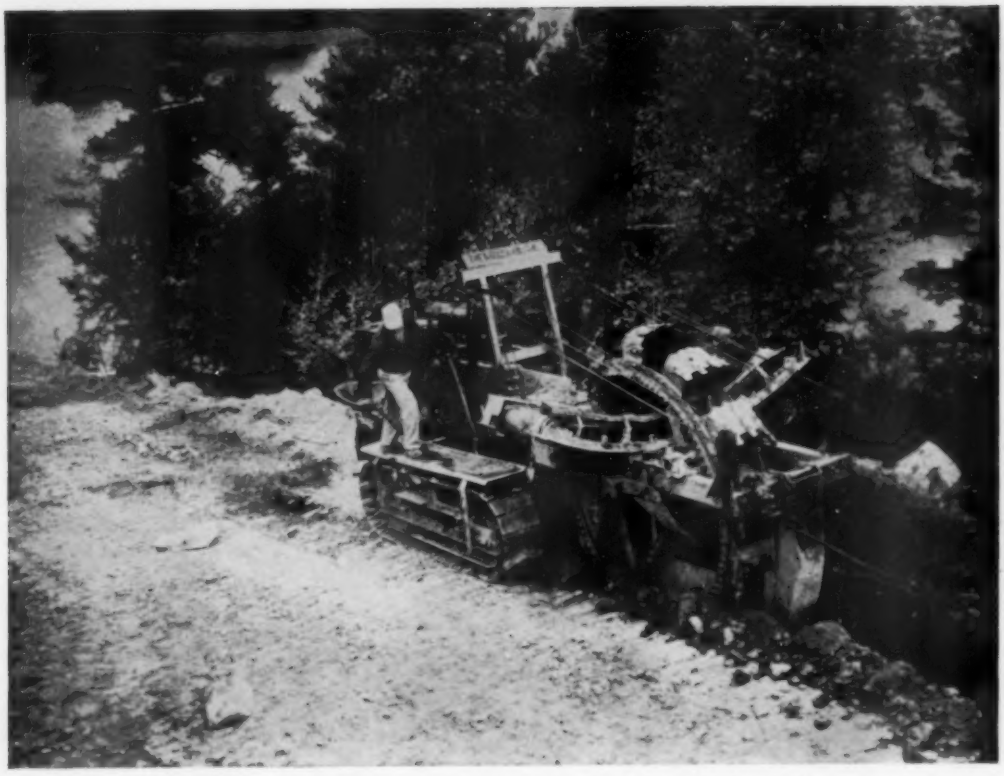
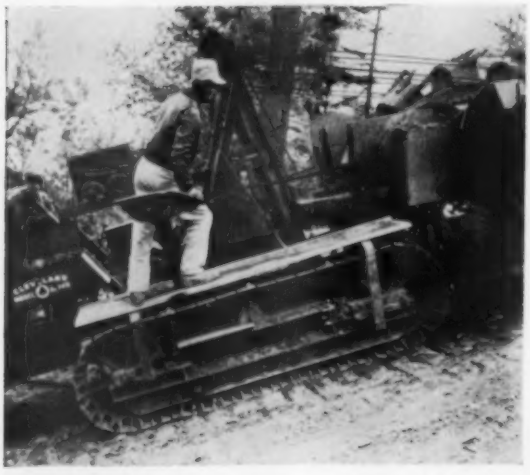


Cleveland 140 digs through rocky New Hampshire hills



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"We got trench with our Clevelands where we thought it would be impossible," says H. J. Burns of Hallen Construction Co., Island Park, N. Y., about a recently completed pipeline job for the Granite State Transmission Co., between Exeter and Somersworth in the rugged New Hampshire hills. The Hallen spread cut through numerous swamps and terrain strewn with boulders and choked with frequent outcroppings of rock.

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mately 10 miles east of the Great Lakes pumping station at Donahue, Iowa, to terminals on the Mississippi River at Bettendorf, Iowa.

- **Gulf Refining Co.**

Project: 530 miles of 10-in. L.P.G. and natural gasoline line from Waddell Plant in Crane County, Texas, to Mont Belvieu near Houston (368 miles is conversion from crude service).

Status: Under way.

- **Laurel Pipeline Co.** (Gulf Refining Co., Sinclair Pipe Line Co., and The Texas Co.)

Project: 100 miles of 24-in. and 340 miles of line graduating down to 14-in. at the west terminus, from Philadelphia refining area to Cleveland.

Status: To start early 1958.
Completion: 1958.

- **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)

Project: 80 miles of 8-in. and 300 miles of 10-in. products and crude line from Four Corners area to Salt Lake City.

Status: Proposed.

- **Ohio Oil Co.**

Project: 350-miles of 12-in. from Wood River, Ill., to Chicago.

Status: Work to start fall 1957.
Completion: 1958.

- **Salt Lake Pipe Line Co.**

Project: 80 miles of 8-in. looping of line from Boise, Idaho, to Pasco Wash.

Status: Pipe has been ordered.
Completion: Late 1957.

- **Southern Pacific Pipe Lines, Inc.**

Project: 100 miles of 10-in., 80 miles of 8-in., and 125 miles of 6-in. between Richmond, Calif., and Fallon, Nev.

Status: Under way.

Contractor: **River Construction Corp.** has 84 miles of 8, 10-in. from Richmond to Stockton, Calif. to complete late spring 1957, F. O Traweek, spread superintendent, office at Richmond. **Hood Construction Co.**, Lynwood, Calif., has 58 miles of 10-in. from Stockton to Roseville, Calif. **Engineers, Limited Pipeline Co.** and **Joe E. Young Pipe Line Construction Co.** have 18 miles of 6 and 8-in. between Roseville and Donner Summit

Completion: August 1, 1957.

- **Trust Pipe Line Co.** (Cosden Petroleum)

Project: 128 miles of 6-in. from Hawley, near Abilene, to Wichita Falls, Tex.

Status: To start July 1957.

Contractor: **Pipe Line Technologists, Inc.**, has the design and engineering.

Completion: October 1957.

- **Underground Storage & Exploration, Inc.**

Project: 393 miles of 12-in. L.P.G. line from Moundsville, W. Va., to Newark, N. J., plus 95 miles of 6, 8-in. laterals to Mauch Chunk, Pa., and to Philadelphia.

Status: Proposed.

- **Union Oil Co. of California**

Project: 815-mile line from Rifle, Colo., to Los Angeles refining area, to carry products from its proposed Rifle shale-oil plant.

Status: Proposed.

U.S. Natural-Gas Pipelines

- **American Louisiana Pipe Line Co.**

Project: 7 miles of 16-in. and 5 miles of 12-in. at North Holly Beach Field and Second Bayou Field, Cameron Parish, La.

Status: Has temporary FPC permit.

- **Arkansas Louisiana Gas Co.**

Project: A 300-mile line from Texas-Louisiana coastal region to northern Louisiana, to connect with their present system, plus gathering lines.

Status: Long-range plans.

- **Atlantic Seaboard Corp.**

Project: 14 miles of 26-in. looping in

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The H₂Oil Gas Gard is a safety device carefully designed and engineered to assure 100% protection against the numerous hazards involved where wet gas installations prevail. Its diversified applications make this unit a "MUST" where safety and economy are the prime objectives. Positive shut-off. 4" x 30" 125#—$54.50, F.O.B. Tulsa, Okla. Available in any size and pressure.

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The H₂Oil "Gage-it" retails for $42.50. Approximate Packaged Weight Two Lbs. Standard Length Gage Tapes Available on Request.

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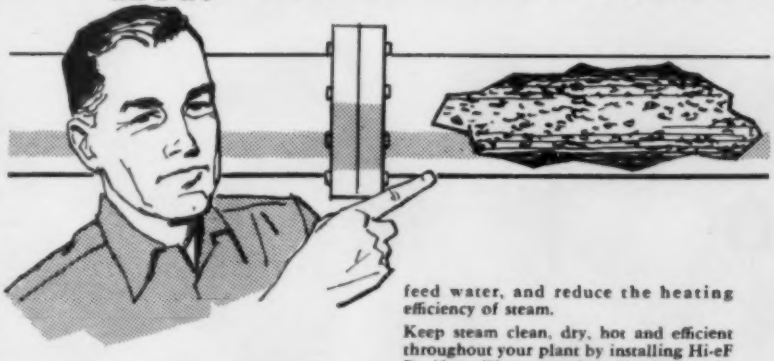

We don't blame you for worrying about wet, dirty, or oily steam. It can damage engines and turbines, slow up production processes requiring steam, contaminate feed water, and reduce the heating efficiency of steam.

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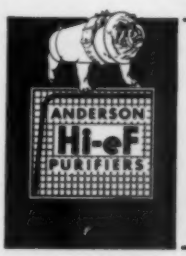

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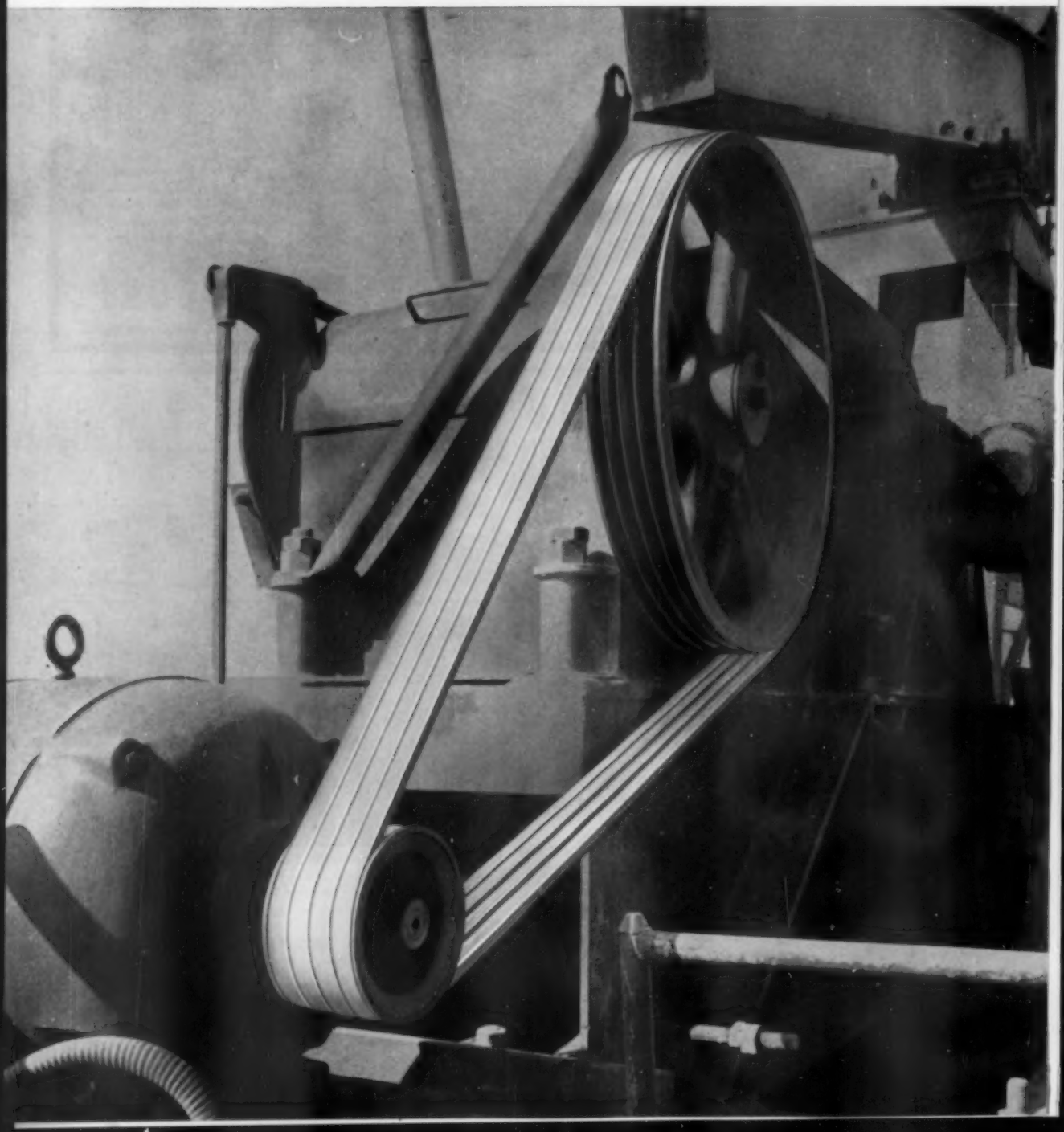


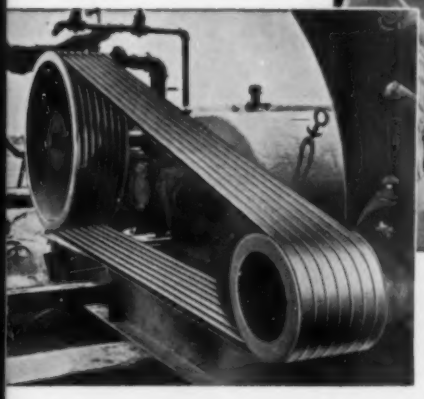
DAYTON V-BELTS

Precision matching divides the load equally . . . guards against overloads and excessive wear

Precision *multi-matching* is an extra Dayton service that doesn't cost one cent more. Yet, it saves you hundreds of dollars in belt and maintenance costs by adding weeks and months of extra life to a set of belts. For *multi-matching* — with the exclusive Dayton Matchometer — insures that each belt is the same length and perfectly mated with every other belt in the entire set.

Actually, every Dayton V-Belt is matched at least three times . . . at the factory, at a regional warehouse, and again before it's delivered to you. Thus, you're always sure that every belt in any set of Dayton Thorobred V-Belts is pulling its proper share of the load without overload or excessive wear.

So, for longer life and reduced costs, insist on *multi-matched* Dayton Thorobreds. Order your next set from your Dayton supplier . . . you'll find him listed at the right.



Every set of Dayton Thorobred V-Belts is *Multi-Matched* on precision Matchometers, the finest device made for matching V-Belts, built exclusively for Dayton Rubber Company.

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Oil City—Oil City Hardware Co.
Shreveport—Bearing Transmission Co.

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All Republic Supply Stores

New Mexico
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All Republic Supply Stores
Oklahoma City—Green Head Service Co.
Tulsa—Engineering Supply Co.

Texas
All Republic Supply Stores
Abilene—Carpenter V-Belt Co.
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Beaumont—Behring's, Inc.
Borger—Radcliff Supply Co.
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Cisco—Walton Electric Co.
Corpus Christi—Alamo Iron Works
Bradley's Motor & Armature Works
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Stewart Dean Co.
El Paso—El Paso Saw & Belting Co.
Freer—Houston-Oil Field Material Co.
Houston—
Behring's Bearing Service Co.
Houston-Oil Field Material Co.
Kilgore—Jack Anderson Engine Co.
Lubbock—Lubbock Electric Co.
Bearing Specialists Co.
Lufkin—Lufkin Foundry & Machine Co.
Midland—Electric Motor Service Co.
Odessa—Duke Electric Co.
Pampa—Radcliff Supply Co.
Pearsall—Houston-Oil Field Material Co.
San Antonio—Alamo Iron Works
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Pipeline Patrol

Hardy and Randolph counties, West Virginia.
Status: Has temporary FPC approval.

- **Carolina Pipeline Co.**
Project: 177 miles of 2, 3, 4, 6, 8, and 10-in. between Blacksburg and Camden, S. C.
Status: Work to start June 1, 1957.
Contractor: **Panama-Williams Corp.** has construction contract. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.

- **Central Hudson Gas & Electric Corp.**
Project: 46 miles of 10-in. from Albany to Kingston, N. Y.
Status: Under way.
Contractor: **Williams-Austin Construction Corp.**, O. L. Martin and Ralph Gaddy, spread superintendents, office at Catskill, N. Y.
Completion: November 1, 1957.

- **Cities Service Gas Co.**
Project: 8 miles of 16-in., 20 miles of 8-in., 20 miles of 6-in., and 20 miles of 4-in. field lines in Barber County, Kansas.
Status: Approved. Under way.
Contractor: **Vaughn & Taylor Construction Co.**
Project: 3 miles of 12-in., 8 miles of 10-in., 4 miles of 8-in., 8 miles of 6-in., and 37 miles of 4-in. field lines in Eureka Field, Okla.
Status: Approved. Under way.
Contractor: **Vaughn & Taylor Construction Co.**
Project: 4 miles of 16-in. at Sarcoxie, Mo.
Status: Approved. Under way.
Contractor: **Prairie Construction Co.**
Project. 64 miles of 6 to 30-in. in Leavenworth and Anderson counties, Kansas, Cass County, Missouri, and Oklahoma County, Oklahoma.
Status: Planned.

- **Coastal Transmission Corp.**
Project: 575 miles of 12, 20, 22, 24-in. main line and 414 miles of 2 to 14-in. gathering lines between McAllen, Tex., and Baton Rouge, La.
Status: To start summer 1957.
Completion: January 1, 1958.

- **Colonial Natural Gas Corp.**
Project: Two systems; one between Houston-Lake Charles area and Miami, Fla.; one in the Carolinas and Georgia.
Status: Proposed.

- **Colorado Interstate Gas Co.**
Project: 1957 program . . . 66 miles of 30-in., 40 miles of 34-in., 109 miles of 26-in., and 100 miles of 24-in. from Springfield, Colo., to Pueblo, Colo; 345 miles of 30-in. from Kit Carson, Colo., to Beatrice, Neb.; 50 miles of 22-in. from Laverne to Hooker, Okla.; 24 miles of 22-in. Panhandle field looping.
Status: Pending FPC approval. Has temporary approval for the 50-mile, 22-in. section in Oklahoma.

- **Eastern Shore Natural Gas Co.**
Project: 34 miles of 8-in. and 90 miles of 6-in. from connection with Transcontinental Gas Pipe Line Corp. in Maryland, across entire length of Delaware to Salisbury.
Status: Pending FPC approval.

- **El Paso Natural Gas Co.**
Project: 74 miles of 34-in. San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: August 1957.
Project: 94 miles of 18-in. from Panoma Plant, Gray County, to Dumas Plant, Moore County, Texas.
Status: Under way.
Contractor: **R. H. Fulton & Co.**
Completion: July 1957.
Project: 177 miles of 20-in. from Sonora Plant, Sutton County, to Plains Plant, Yoakum County, Texas.
Status: Planned. Filed for FPC permit.
Completion: January 1958.
Project: 74 miles of 30-in. Permian-San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: January 1958.
Project: 216 miles of 6 to 34-in. in Arizona, Texas, and New Mexico, plus 533 miles of various size line.
Status: Filed for FPC permit.
Project: 47 miles of 30-in. from proposed

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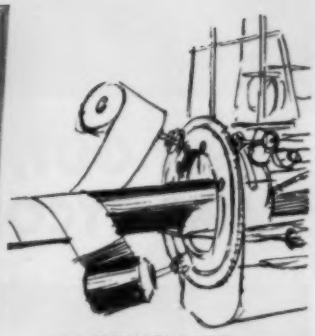
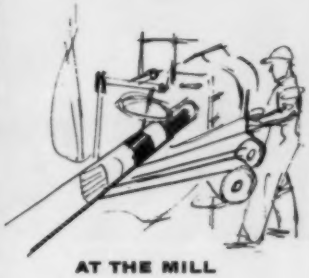


BY TRAVELINER

BY HAND



AT THE MILL

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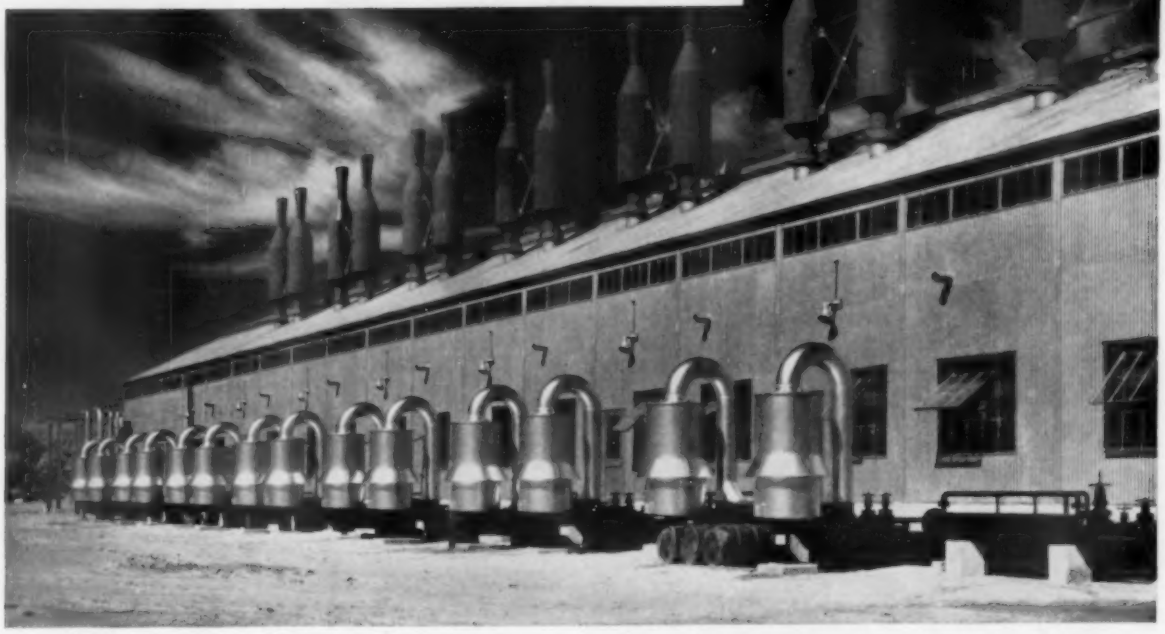

Photo by Elwood M. Payne, Houston

AAF Cycoils play an important part at the Shell Oil Company's Sheridan, Texas cycling plant. Dust stays out of engines and compressors, only clean air goes in.

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AAF Cycoil heavy-duty oil bath air cleaners deliver 4-way cleaning: impingement, scrubbing, cyclonic action and filtering. Actual tests, plus on-the-job operation, prove that more than 90% of the fine dust content of air is trapped in oil and removed by centrifugal action—*before it even reaches the filter pads.* No wonder Cycoils deliver air that's virtually 100% *dust-free.*

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Pipeline Patrol

Lindrith, N. M., plant to proposed Chaco, N. M., plant.

Status: Under way.

Contractor: **Foutz & Bursum Construction Co.**

Completion: 1957.

Project: 38 miles of various size line to make additional gas available for processing at the McElroy-Wilshire gasoline plant (recently purchased from Lone Star Producing Co.) near Crane, Tex.

• **Houston Texas Gas & Oil Corp.**

Project: 702 miles of 24-in. from Baton Rouge, La., to Kissimmee, Fla.; 240 miles of 18-in. from Kissimmee to Cutler, Fla.; 642 miles of 3 to 18-in. sales laterals in Florida. Main line to join Coastal Transmission's proposed line from McAllen, Tex., to Baton Rouge.

Status: To start June 1957.

Contractor: **Midwestern Constructors** has the 702 miles of 24-in.; **Harbert Construction Corp.** has remainder.

Completion: June 1958.

• **Iron Ranges Natural Gas Co.**, St. Paul.

Project: 68-mile transmission line and 47 miles of laterals to supply towns on the Mesabi Iron Range, Minn.

Status: Application pending with FPC.

• **Kansas-Nebraska Natural Gas Co.**

Project: 61 miles of various size gathering line in Camerick field, Texas County, Oklahoma.

Status: Approved.

• **Michigan Consolidated Gas Co.**

Project: 67 miles of 10 and 12-in. between Sears and Travers City, Mich.

Status: Under way.

Contractor: **Somerville Construction Co.**; Floyd Huduall, spread superintendent, office at Cadillac, Mich.

Project: 60 miles of 10 and 12-in. between Muskegon and Ludington, Mich.

Status: Under way.

Contractor: **Somerville Construction Co.**, jointly with **J. L. Gentry Construction**; Frank Morris, spread superintendent, office at Hart Mich.

• **Michigan Wisconsin Pipe Line Co.**

Project: 24 miles of 24-in. and 18 miles of various size looping in Michigan, Indiana, Illinois, Wisconsin, Iowa, and Missouri.

Status: Approved.

Completion: October 1, 1957.

• **Midwestern Gas Transmission Co.**

Project: Will build main line from Portland, Tenn., to Canadian border near Emerson, Man.; 829 miles of 24-in., 109 miles of 16-in., 174 miles of 12-in., 648 miles of 3 to 18-in. extensions in Minnesota and Wisconsin.

Status: Application pending with FPC.

• **Mountain Fuel Supply Co.**, Salt Lake City

Project: 38 miles of line to connect with Pacific Northwest Pipeline Corp.'s system in Sweetwater County, Wyoming.

Status: Has temporary FPC permit.

• **Natural Gas Pipeline Co. of America**

Project: 350 miles of 20 and 26-in. from Jack and Wise counties, Texas, to Fritch Tex., plus a gathering system.

Status: Under way.

Contractor: **R. H. Fulton & Co.** has Red River crossing in northern Montague County. **Fulton & Brodie, Inc.**, Lubbock, Tex., has gathering system.

Completion: Total project to be completed by December 1, 1957.

Project: 389 miles of 36-in. loops along its line from Beatrice, Neb., to Chicago, to take gas from proposed line of Colorado Interstate Gas Co., and for 91 miles of 30-in. loops along parts of its main line.

Status: Application pending with FPC.

Project: 337 miles of 30-in. between Fritch, Tex., and Beatrice, Neb., and 59 miles of

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Pipeline Patrol

36-in. between Beatrice and Joilet, Ill., along Natural's existing system from the Texas Panhandle to Chicago.

Status: Pending FPC approval.

Completion: 1959.

• **New York State Natural Gas Corp.**

Project: 15 miles of 30-in. from Horseheads to Newfield, N. Y.; 31 miles of 20-in. from Harrison to Woodhull, N. Y.; 10 miles of 12-in. from Stockbridge to Oneida, N. Y.

Status: Planned.

• **Niagara Mohawk Power Corp.**

Project: 14 miles of 18-in. from Phoenix to Palermo, N. Y.

Status: Planned.

Completion: October 1, 1957.

Project: 261 miles of 2 to 16-in. transmission and distribution mains to service areas in central, eastern and northern New York state.

Status: Planned.

Contractor: Various.

Completion: December 31, 1957.

• **North Carolina Natural Gas Corp. (Subsidary of Colonial Natural Gas Corp.)**

Project: 630 miles of 2 to 16-in. from Transcontinental Gas Pipe Line Corp.'s system near Mooresville, eastwardly across north Carolina.

Status: To start fall 1957.

Completion: Spring 1958.

• **Northern Natural Gas Co.**

Project: 160 miles of 2, 3, 6, 8-in. branch lines to serve 20 new communities on Aberdeen, S. D., line.

Status: Under way.

Contractor: **Troth Construction Co.**

Project: 73 miles of 20-in. from Savana Creek to Pincher Creek fields in Alberta, Canada; 32 miles of 24-in. from Pincher Creek to Montana border; 1,100 miles of 26-in. from Montana into Minneapolis.

Status: Planned.

Project: 365 miles of main line and 1,090 miles of branch lines to serve communities in Minnesota, Iowa, South Dakota, Nebraska, and Wisconsin.

Status: Filed with FPC March 18, 1957.

• **Offshore Gathering Corp.**, Houston.

Project: 364 miles in Gulf of Mexico off Louisiana.; 60 miles of 24-in., 70 miles of 26-in., 234 miles of 30-in. (Dual line.)

Status: Application pending with FPC.

• **Ohio Fuel Gas Co.**

Project: 7 miles of 12-in. near Fremont, Ohio.

Status: Planned.

Completion: First half 1957.

Project: 23 miles of 18, 20-in. from Gibsonburg to Toledo.

Status: Uncertain.

Project: 152 miles of line in Ohio: 43 miles of 24-in. from Crawford Station to Utica; 18 miles of 24-in. from Pavonia Station to Line D; 6 miles of 20-in. from Mount Gilead to Claridon; 4 miles of 20-in. near Dayton; 4 miles of 20-in. near South Charleston; 7 miles of 16-in. near Springfield; 6 miles of 20-in. nnear Oberlin; 17 miles of 20-in. from Oak Hill to Symmes Station; 7 miles of 12-in. from Mount Sterling to Bloomingburg; 2 miles of 8-in. near Bellefontaine; 3 miles of 12-in. near Mansfield; 4 miles of 12-in. near Lakeville; 7 miles of 8-in. in Guernsey and Belmont counties.

Status: Under way.

Contractor: **O. R. Burden Construction Corp.** has the 43 miles of 24-in. from Sugar Grove near Crawford station, to Utica, Ohio, C. M. Hoffman, spread superintendent.

Completion: O. R. Burden Construction Corp., section to be completed July 1, 1957. Remainder to be completed second half 1957.

• **Pacific Gas & Electric Co.**

Project: 37 miles of 20-in., 37 miles of 18-in., 3 miles of 16-in. from Beehive Bend field

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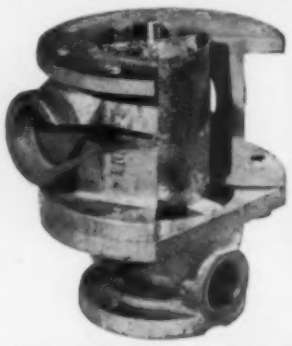

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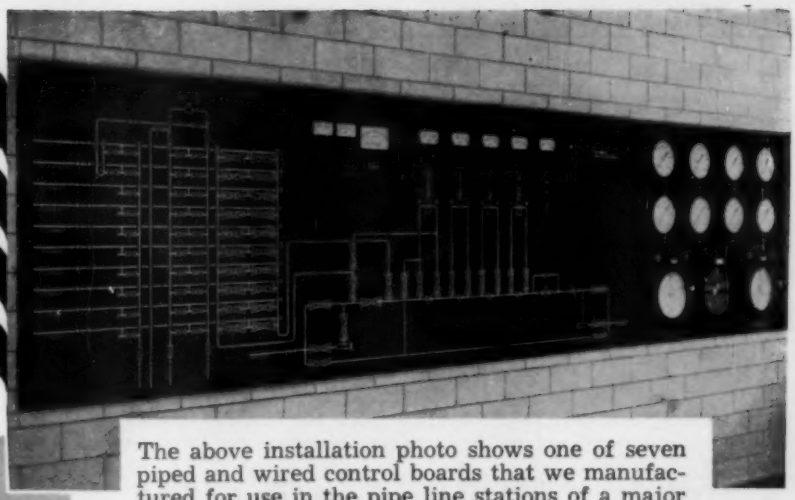

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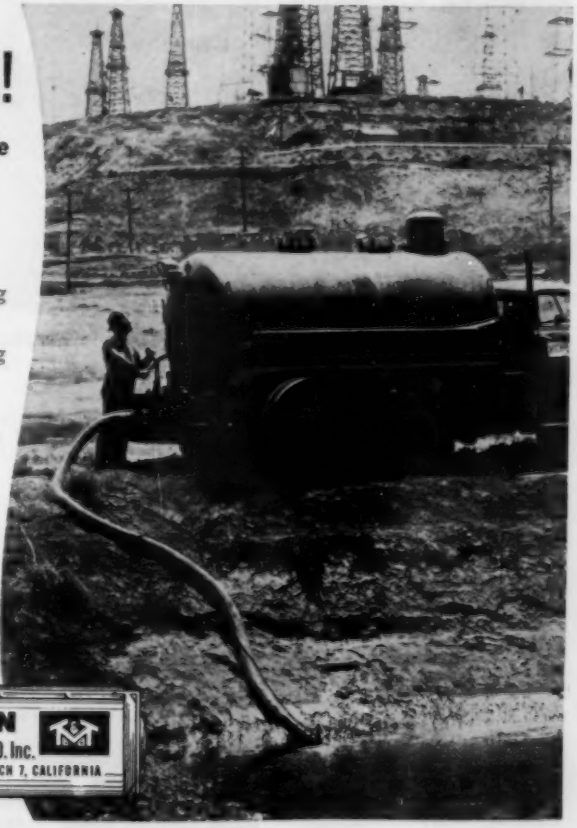

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Pipeline Patrol

near Willows, Calif., to near Davis, then to Sacramento.
Status: Under way.
Contractor: **Engineers Limited Pipeline Co.**
Completion: June 1957.
Project: 138 miles of 34-in. looping of the Topock-Milpitas line.
Status: Under way.
Contractor: **Midwestern Constructors, Inc.**
Completion: December 1, 1957.
Project: 5 miles of 16-in., 160 miles of 12-in., 8 miles of 6-in. from Corning to Eureka, Calif., to connect company's Humboldt Division with integrated gas system.
Status: Planned.
Completion: January 1958.
Project: 13 miles of 12-in., 2 miles of 10-in., from Santa Cruz to Davenport, Calif.
Status: Planned.
Completion: October 1957.

• **Pacific Northwest Pipeline Corp.**
Project: 37 miles of 6-in. from Dove Creek to Nucla, Colo., and 13 miles of 4-in. from Nucla to Urvan, to serve Union Carbide Nuclear Co. and Vanadium Corp. of America.
Status: Has FPC permit.
Project: 1,000 miles of gathering lines and laterals along present line.
Status: Planned.
Completion: 1957.

• **Pennsylvania Gas Co.**
Project: 23 miles of 10-in. in Erie County, Pa., 15 miles of 8-in. in Warren and Chautauqua counties, Pennsylvania, 30 miles of branch lines and a number of small distribution systems.
Status: Has FPC permit.

• **Peoples Natural Gas Co.**
Project: 58 miles of 2 to 14-in. extension and replacement lines in Pennsylvania.
Status: Under way.
Completion: September 1957.

• **Permian Basin Pipeline Co.**
Project: 83 miles of 16-in. from its Spraberry station in Midland County, Texas, to tie in with Pioneer Gathering System, Inc., at a point in northwestern Schleicher County, Texas.
Status: Filed for FPC approval.

• **Phillips Petroleum Co.**
Project: 3 miles of 24-in. in Moore County, Texas.
Status: Planned.
Completion: October 1, 1957.
Project: 30 miles of 3 to 8-in. in Moore, Hutchinson, Sherman, Hansford, and Gray counties, Texas, and in Texas County, Oklahoma.
Status: Planned.
Contractor: Various.
Completion: January 1, 1958.

• **Piedmont Gas Co.,** Hickory, N. C. (Parent is Carolina Natural Gas Corp.)
Project: 78 miles of 2 to 8-in. extension off Trancontinental in North Carolina to serve Gaston, Lincoln, Catawba, Caldwell, and Burke counties.
Status: Has FPC approval.

• **Pioneer Gathering System, Inc.**
Project: 27 miles of 16-in. and 27 miles of 12-in. in Schleicher and Sutton counties, Texas.
Status: Filed for FPC approval.
Completion: July or August 1957.

• **Signal Oil & Gas Co.**
Project: 80 miles of gathering lines serving Tioga, N. D., gasoline plant; system being extended to Antelope, North Blue Buttes, and South Blue Buttes fields, McKenzie County, North Dakota.
Status: Under way.
Contractor: **C. P. Bartley & Son,** Tioga, N. D.
Completion: October 1, 1957.

• **Southern California Edison Co.**
Project: 200-mile line from San Joaquin Valley gas fields to power plant at Redondo Beach, Calif.
Status: Under way.
Completion: 1957.

• **Southern California Gas Co. and Southern Counties Gas Co. of California.**
Project: 241 miles of 30-in. from the outskirts of Los Angeles to Topock on the Arizona-California border.
Status: Under way.
Contractor: **R. H. Fulton & Co.,** spread offices at Palmdale and Barstow, Calif.
Completion: June 30, 1957.
Project: 4 miles of 30-in. from Los Angeles River to Victoria Station at Los Angeles.
Status: Planned.
Completion: July 30, 1957.

• **Southern Natural Gas Co.**
Project: 10 miles of 8-in. laterals in Napoleonville Field and Fort Jackson Field, La.
Status: Has FPC approval.
Completion: December 1, 1957.
Project: 32 miles of 6-in. from Chandeleur Sound area, Breton Island, La.; 7 miles of 8-in. and 5 miles of 10-in. from Main Pass area to Olga, La.; 9 miles of 8-in. from Bastian Bay Field to Fort Jackson Field; 7 miles of 8-in. laterals in Manila Village Field.
Status: Plan to apply for FPC permit.
Completion: December 1, 1957.

• **Spokane Natural Gas Co.**
Project: 400 miles of 1 through 24-in. distribution system at Spokane.
Status: Under way.
Contractor: **Hallmac Construction Co.;**

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Pipeline Patrol

V. L. Williams, spread superintendent, office at Spokane.

Completion: 1957.

• **Tennessee Gas Transmission Co.**

Project: 221 miles of 30-in., 101 miles of 26-in., and 10 miles of 24-in. looping from Portland, Tenn., to Greenup, Ky.; from Morehead, Ky., to Catlettsburg, Ky.; from Catlettsburg to Broad Run, W. Va.; from New Wilmington, Pa., to Mercer, Pa.; and from New Castle, Pa., to near Pittsburgh, Pa.

Status: Pending FPC approval.

Project: 51 miles of 26-in., 51 miles of 20-in., and 17 miles of 12-in. gathering lines from Kinder, La., to offshore fields in Gulf of Mexico.

Status: Has temporary FPC approval.

Project: 577 miles of 30-in. from Mississippi River delta area south of New Orleans to Portland, Tenn.

Status: Pending FPC approval.

Project: 76 miles of 24-in. between Coudersport, Pa., and Hamburg, N. Y.

Status: Pending FPC approval.

• **Texas Eastern Transmission Corp.**

Project: 422 miles of 30-in. from near McAllen to Beaumont, Tex., to move imported Mexican gas; 45 miles of 24-in. laterals from McAllen to Provident City, Tex., 77 miles of 30-in. looping between Kosciusko, Miss., and Uniontown, Pa.; 147 miles of supply and sales laterals.

Status: Under way.

Contractor: **Houston Contracting Co.** has 121 miles of 30-in. between Angleton and Vidor, Tex. **H. C. Price Co.** has 70 miles of 30-in. **H. B. Zachry Co.** has 201 miles of 30-in. starting near McAllen and running northeast to near Angleton, Tex. **Grayco Constructors, Inc.** has 45 miles of 24-in. laterals from Blessing to Provident City. **Western Pipe Line, Inc.,** Austin, has 30-in. crossings at Nueces, Lavaca, and Carancahua bays. **Missouri Valley Dredging Co.,** Omaha, has crossings at Hinds and Guadalupe bays. **Altgelt Construction Co., Inc.,** has 100 miles of 3, 4, 6, 8-in. gathering lines in the Corpus Christi area.

Project: 17 miles of 8-in. and 3 miles of 6-in. from its 20-in. Baytown-Hankamer line to Alco-Mag field in Harris County, Texas.

Status: Has FPC approval.

Project: 97 miles of 30-in. loops between Kosciusko, Miss., and Uniontown, Pa., and 40 miles of new lateral supply lines.

Status: Filed for FPC permit March 15, 1957.

Completion: September 1, 1957.

Project: 667 miles of 30-in. from Kosciusko, Miss., to Uniontown, Pa.

Contractors: **H. C. Price Co.** has 64 miles from Barton, Ala., to Mt. Pleasant, Tenn., 51 miles from Mt. Pleasant to Gladevile, Tenn., 52 miles from Gladeville to Tompkinsville, Ky., 68 miles from Tompkinsville to Danville, Ky., 63 miles from Danville to Owingsville, 46 miles from Owingsville to Wheelersburg, Ohio. (Four spreads will be used). **Williams Brothers Co.** has 63 miles from Egypt, Miss., to Barton, Ala., 64 miles from Berne, Ohio, to Uniontown, Pa. **Houston Contracting Co.** has 80 miles from Kosciusko, Miss., to Egypt, Miss., 57 miles from Wheelersburg to Athens, Ohio, 61 miles from Athens to Berne, Ohio.

Completion: Fall 1957.

• **Texas Illinois Natural Gas Pipeline Co.**

Project: 10 miles of 36-in. to loop existing single 30-in. near Joliet, Ill.

Status: Has FPC approval.

• **Transcontinental Gas Pipe Line Corp.**

Project: 172 miles of 36-in., 68 miles of 30-in., 162 miles of 24-in., and 64 miles of smaller diameter pipe to loop main line from Texas to New Jersey.

Status: Work in North Carolina under way.

Contractor: **Western Construction Co.** has 65 miles of 36-in. and 45 miles of 30-in. at scattered spots along the system in South Carolina, North Carolina, Pennsylvania, and Virginia. Western will start work in North Carolina, spread office at Winston-Salem.

Completion: Total project to be completed December 1957.

Project: 110 miles of 36-in., 16 miles of 30-in., and 13 miles of 24-in. looping in S. Car., Ga., Ala., Miss., and La.

Status: Under way.

Contractor: **Sharman, Allen, Gay & Taylor, Inc.**

Completion: November 1957.

Project: 29 miles of 16-in. lateral off the coast of Cameron Parish, La., and extending to company's existing system near Lake Charles.

Status: To start about June 1, 1957.

Project: 57 miles of main line in Louisiana, Mississippia, Alabama, Georgia, and South Carolina, and 226 miles of laterals in Texas and Louisiana.

Status: Filed for FPC permit, May 3, 1957.

• **United Gas Pipe Line Co.**

Project: 40 miles of 8-in. from Baldwin County, Alabama, to Container Corp.'s plant.

Status: Has FPC permit.

Canadian Crude-Oil Pipelines

• **Act Oils, Ltd.** (subsidiary of Canada Southern Petroleums, Ltd.)

Project: A 450-mile line from the Peace River region of northern B. C. to tidewater at Bella Coola, B. C.

Status: Request has been made for permit from the B. C. government.

• **B-A Alberta Pipe Line, Ltd.**

Project: 35 miles of 8-in. to connect Drumheller field, Alberta, with existing lines running to Edmonton.

Status: Pending approval.

• **Gibson Crude Oil Purchasing Co., Ltd.**

Project: 19 miles of 6-in. from the Bells-

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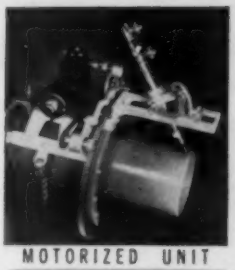

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Pipeline Patrol

hill Lake oil field, Northeastern Alta., to tie in with Interprovincial Pipe Line's pump station near Hardisty, plus 3 miles of lateral lines.

Status: To start as soon as weather permits.

Contractor: **Hutchison Construction, Ltd.**, of Leduc, Alta., has construction contract. **Petrol-Structors, Ltd.**, of Calgary, are designing and supervising construction.

Completion: Late June, 1957.

• **Interprovincial Pipe Line Co.**

Project: 156 miles of 20-in. to extend present line from Sarnia to Port Credit, Ont.

Status: Under way.

Contractor: **Somerville Construction Co.** has 90 miles; **Majestic Contractors, Ltd.**, has 66 miles, Earl Saulsman, spread superintendent, office at Galt.

Completion: September 1, 1957.

Project: 33 miles of 24-in. from Kendal to Peebles, Sask.

Status: To start June 1, 1957.

Contractor: **Fulton Banister, Ltd.**, John O'Rourke, superintendent, office at Wolseley, Sask.

Completion: July 31, 1957.

Project: 79 miles of 26-in. from Clearbrook Minn., to Superior, Wis.

Status: To start June 1, 1957.

Contractor: **R. H. Fulton & Co.**

Completion: August 31, 1957.

• **Pembina Pipe Line, Ltd.**

Project: 100 miles of 3 to 12-in. gathering line in Pembina oil field.

Contractor: **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., T. Childress, spread superintendent, office at Drayton Valley, Alta.

Completion: November 1, 1957.

Project: 32 miles of 16-in. from Calmar to Edmonton, Alta.

Status: Under way.

Contractor: **Universal Pipe Lines, Ltd.**, subsidiary of Mannix, Ltd., Otis Hare, spread superintendent, office at Calgary, Alta.

Completion: July 1, 1957.

• **Rangeland Pipe Line Co.**

Project: 48 miles of 12-in. between Sundre and the Sylvan Lake in south-central Alberta.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.**

Completion: June 15, 1957.

• **Royalite Oil Co., Ltd.**

Project: 250 miles of line to move oil from the Athabasca oil sands of northeastern Alberta to Edmonton.

Status: Long range plans.

Completion: 1960.

• **Trans Mountain Oil Pipe Line Co.**

Project: 100 miles of 30-in. loops: 50 miles east of Kamloops, B. C., and 50 miles west of Edson, Alta.

Status: Under way.

Contractor: **Marine Pipeline & Dredging, Ltd.**, has Thompson River crossing, B. C., J. H. McCartney, spread superintendent, office at Kamloops, B. C. **R. A. Conyes Construction Co.** has the 50 miles east of Kamloops; **Dutton-Williams Brothers, Ltd.** has the other 50 miles.

Completion: River crossing will be done by June 15, 1957; remainder by July 31, 1957.

• **Westspur Pipe Line Co.**

Project: 20 miles of 12-in. from Alida in southeastern Saskatchewan, to the Carnduff-Glen Ewen area to tap Cantal, Hastings, Florence, Carnduff, and Glen-Ewen fields: 34 miles of 4, 6, 8-in. gathering lines.

Status: Has requested permit from Board of Transport Commissioners.

Contractor: **Majestic Contractors, Ltd.**, Jeff Minter, spread superintendent, office at Estevan, Sask.

Completion: No date set.

Project: 75 miles of 16-in. from Steelman,

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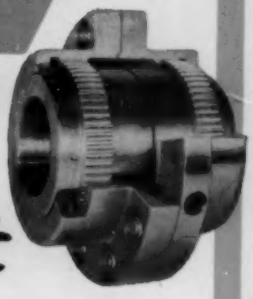

STRENGTH —Hubs and cover sleeves for sizes 1¼ A through 7A are machined from tough steel forgings. Hubs are keyed to the shafts. The two one-piece cover sleeves function as a single, rigid unit serving as a floating connecting link between the hubs. High strength of forgings makes possible a very compact coupling with low rotating inertia.

RELIABILITY —There are no flexible parts to bend or break and the coupling is dust, moisture, and oil tight. Patented Walflex seal is positioned where centrifugal force is least. Clearance between teeth in hubs and sleeve is engineered so that an oil wedge always separates them, taking the wear.

SERVICE —Plenty of rough bore couplings, already assembled—on the shelf for *immediate* delivery. Finish bored standard couplings shipped to meet customers' schedules. We are geared up to give you realistic delivery on *any* type of couplings.

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THE GUIBERSON CORPORATION, Dallas, Tex.—Swabs, packers, anchors, workover equipment—drilling heads, blowout preventers, tubing blocks, hooks, swivels, kellys, savers, unions. Gas lift equipment. Molded rubber products.

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IDECO, Dallas, Tex.—Hydrair® and Power Rigs; Full-View® Masts; substructures; single, dual and Drive-In Rambler Rigs; blocks, swivels, rotaries; mud pumps; petroleum equipment and supplies.

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LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City Okla.—Electric and Radioactivity Well Logging, Koneshot® perforating and bullet perforating, packers and bridging plugs.

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MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar® and Magcogel® drilling muds and other specialized oil well drilling fluids and chemicals.

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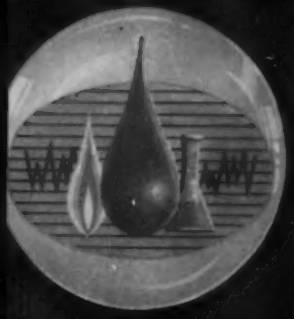
PACIFIC PUMPS, INC., Huntington Park, Calif.—Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.



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SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif.—Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.

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Pipeline Patrol

Sask., to Cramer, Man., Canada.
Status: Under way.
Completion: July 30, 1957.

Canadian Products Pipelines

• **Hydrocarbons Pipeline Co.** (Subsidiary of Canadian Hydrocarbons).

Project: 800 miles of 6 and 8-in. L.P.G line from near Edmonton, Alta., to Fort William, Ont.

Status: Has permit from Parliament of Canada. If approved by Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board, work will start in 1957.

Construction consultants: **Dutton-Williams Brothers, Ltd.**, Calgary, and **A. D. Little & Co.**, Boston.

Canadian Gas Pipelines

• **Alberta Gas Trunk Line Co., Ltd.**

Project: 637 miles of 34 to 16-in. gathering lines in Alberta.

Contractor: **Dutton-Williams Brothers, Ltd.** has preliminary studies, design and management-engineering. **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., jointly with **Marine Pipeline & Dredging Co.**, has crossing of Red Deer River near Cavendish, Alta., J. Hysuick, spread superintendent, office at Empress. **Fulton Banister, Ltd.**, has 17 miles of 34-in. west from Trans-Canada pipeline origin near Burstall, Sask., to near Cavendish, Alta., and 100 miles of 18-in. north to Bindloss and Provost fields, John O'Rourke and George Caron, superintendents, office at Empress, Alta.

Status: River crossing completed. Total project to be completed in 1960.
Status: Under way.
Completion: Summer 1957.

• **Inland Natural Gas Co., Ltd.**

Project: 304 miles of mainline and 25 miles of laterals from Savona to Nelson, B. C.: 150 miles of 12-in.; 112 miles of 10-in.; 67 miles of 6-in. Also will build 400 miles of distribution piping in 31 towns.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.**; Pat Campbell, project manager, office at Penticton.

Completion: October 1, 1957.

• **Northern Ontario Pipe Line Crown Corp.** (formed by the federal and Ontario governments).

Project: 675 miles of 30-in. from the Ontario-Manitoba border to near Kapuskasing, Ont. (part of the 2,250-mile Trans-Canada line. Upon completion this section will be leased to Trans-Canada Pipe Line Co. with option to buy.)

Contractor: **Dutton Williams Brothers** has 58 miles from the Manitoba-Ontario border west of Kenora to a point east of the crossing of Ontario Highway 17. **Morrison Shivers, Ltd.** has 94 miles from the east crossing of Highway 17 to a line separating the townships of Hyndman and Hodgson. **Majestic Contractors & Associates** has 80 miles from the Morrison Shivers terminal to Stedman Township. **Houston Contracting Co.** has 79 miles from Stedman to Forham Township. Remainder not let.

Completion: End 1957.

• **Plains-Western Gas & Electric.**

Project: 16 miles of 10-in. from the Trans-Canada Pipe Line to Brandon, Manitoba.

Contractor: **Banister Construction, Ltd.**, Jim Boyce, superintendent.

Completion: 1957.

• **Saskatchewan Power Corp.**

Project: 13 miles of 4-in. lateral to town of Kerrobert, and 10 miles of 6-in. lateral to Kindersley Power Plant, Sask.

Status: Planned.

Contractor: **Banister Construction, Ltd.**

Completion: July 15, 1957.

Project: 300 miles of 1 to 20-in. distribution lines at Regina, Sask.

Status: Planned.

Contractor: **S. E. Construction (Alberta) Ltd.**, and **Pacific Pipeline Construction (Alberta), Ltd.**, jointly.

• **Trans-Canada Pipe Lines, Ltd.**

Project: 574 miles of 34-in. from the Alberta-Saskatchewan border to Winnipeg. (First part of 2,250-mile line from Alberta to Toronto and Montreal. One 675-mile section is being built by Northern Ontario Pipeline Crown Corp.)

Status: Under way.

Contractors: **Majestic Contractors, Ltd.** (104 miles from Burstall to Stewart Valley, Sask., R. L. Leonard, spread supt., office at Cabri.; **Canadian Bechtel, Ltd.** (110 miles from Swift Current to Moose Jaw, Sask., J. L. Work, general supt., office at Moose Jaw, and 54 miles from Portage la Prairie to Winnipeg); **Universal Pipe Line, Ltd.**, subsidiary of **Mannix, Ltd.**, (90 miles from Moose Jaw to Welseley, spread superintendent, Otis Hare, office at Regina, Saskatchewan); **Dutton-Williams Brothers, Ltd.** (97 miles from Deveren to Moosomin, under way, to complete August 1957). **Price-Poole of Canada, Ltd.**, has 100 miles from Miniota to near McGregor to start in 1957. **Marine Pipeline & Dredging, Ltd.** has 30-in. Red River and Assiniboine crossing in Manitoba.

Completion: Red River crossing to be completed May 31. Assiniboine River crossing completed. Remainder to be completed by September 1957.

Project: 82 miles of 30-in. from near Winnipeg to the Ontario-Manitoba border.

Status: Under way.

Contractor: **Majestic Contractors, Ltd.**, K. B. Killingsworth, spread superintendent, office at Ste. Anne, Man.

Completion: October 15, 1957.

CSI-designed selenium rectifier like those used on the job described below.

MAJOR PIPELINE PROTECTED WITH RECTIFIERS AND ANODES

A major pipeline company needed cathodic protection on a line that runs through six states. It asked for competitive bids.

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CSI has 20-foot power augers, ditching machines and trained personnel to help you with your installation problems. CSI also offers expert consultation service and brand-name cathodic protection materials—including Dow magnesium anodes.

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Pipeline Patrol

• **Union Gas Co. of Canada, Ltd.**

Project: 142 miles of 26-in. from Dawn Township to Hamilton, Ontario, plus 55 miles of 6 to 20-in. laterals, and 317 miles of 2 to 12-in. distribution lines.

Status: Planned.

Completion: November 30, 1957.

Project: 17 miles of 8 to 20-in. storage lines in Dawn Township, Ontario.

Status: Planned.

Completion: August 1957.

• **Westcoast Transmission Co., Ltd.**

Project: 650 miles of 30-in. from Peace River area, Canada, to Sumas, Wash.

Status: Under way.

Contractors: **Dutton - Williams Brothers, Ltd.,** has 120 miles from Taylor, B. C., to Azouzetta Lake, completed; **Universal Pipe Lines, Ltd.,** subsidiary of **Mannix, Ltd.,** has 110 miles between Huntingdon and Kingsvalle, B. C., F. L. Byers, spread superintendent, office at Hops, B. C.; **Canadian Bechtel, Ltd.,** has 210 miles from Alexandria to Pine Pass, B. C., H. F. (Hank) Mogg, spread man, office at Quesnel, B. C.; **R. A. Conyes Construction Co.,** has 210 miles; **River Construction Corp., Ltd.,** has under way 150 miles of gathering lines in northern Alberta and British Columbia; **Marine Pipeline & Dredging, Ltd.,** has Fraser and Peace River crossings, Waldo Trim, spread superintendent, offices at Fort Saint John and Hope, B. C.

Completion: Dutton-Williams section completed. R. A. Conyes section and Canadian Bechtel section to be completed September 1957. Marine Pipeline work to be completed June 30, 1957. Universal Pipe Lines, Ltd. will complete work September 1, 1957.

Project: 174 miles of 30-in. from Savanna Creek area to the Canadian-Idaho border.

Status: Proposed.

Foreign Crude-Oil Pipelines

• **Aramco-I.P.C.-Iranian Consortium.**

Project: 1,500 miles of 38 or 40-in. line from Persian Gulf to Mediterranean at Iskenderun, Turkey.

Status: Proposed.

• **Bolivian Gulf Oil Corp.**

Project: 160 miles of 10-in. and 43 miles of 8-in. from Sicascia to Arica on the Chilean coast.

Status: Awaiting pipe.

Contractor: **Williams Brothers Co.**

Completion: December 1957.

• **Caltex**

Project: 30 miles of 30-in. from Duri field in Sumatra to Dumai where a deepwater terminal will be built. Line will be extended 35 miles of Minas field later.

Status: Planned.

Completion: Duri-Dumai line to be finished in 1959; extension to Minas later.

• **Colombian Petroleum Co.**

Project: 42 miles of 6-in. from Tibu field to Rio de Oro in Colombia.

Status: Under way.

• **C.R.E.P.S., Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (SN Repal), and Cie. Francaise des Petroles Algerie**

Project: Two 10-in. lines from Hassi Messaoud and Edjele, Algeria to the railhead at Touggourt.

Status: Planned.

Completion: 1958.

• **Creole Petroleum Corp.**

Project: 87 miles of 30-in. from Temblador field to Caripito in Venezuela.

Status: Planned.

Completion: 1959.

Project: 9 miles of 26-in. from Ule to La Salina in Venezuela.

Status: Planned.

Completion: Late 1957.

• **Deutsche-Shell A.G.**

Project: 120 miles of 20, 24-in. from Marseilles, France, to Rotterdam, Germany, to tap the proposed 700 mile trans-Europe line being considered by the Royal Dutch-Shell Group.

Status: Planned.

Completion: 1960.

• **Iraq Petroleum Co.**

Project: About 600 miles of up to 40-in. from Kirkuk field through Iraq and Turkey to the Turkish port of Iskenderun on the Mediterranean sea.

Status: Proposed. Survey completed.

• **Mene Grande Oil Co.**

Project: 97 miles of 30-in. from fields in Eastern Venezuela to Puerto La Cruz.

Status: Under way.

Contractor: **Fulghum Contracting Corp.** has 22 miles between Oficina and Anaco.

Completion: First quarter 1958.

• **National Iranian Oil Co.**

Project: A 1,000-mile line to move Qum crude to the Mediterranean.

Status: Under study.

• **North-West Oil Pipelines Co.** (newly formed by six West German refiners, headed by affiliates of Standard Oil Co. (N.J.), and British Petroleum Co., Ltd.)

Project: 210-mile line from the refining centers in the industrial Ruhr area of West Germany to Wilhelmshaven.

Status: Planned.

Completion: 1959.

• **Royal Dutch-Shell**

Project: 700-mile line across Europe from the Mediterranean to the North Sea, running through Eastern France, Luxembourg, West Germany, and Netherlands, and Belgium. Main trunk to be 30-in.

Status: Company is considering project together with several other companies.

(Continued on page 338)

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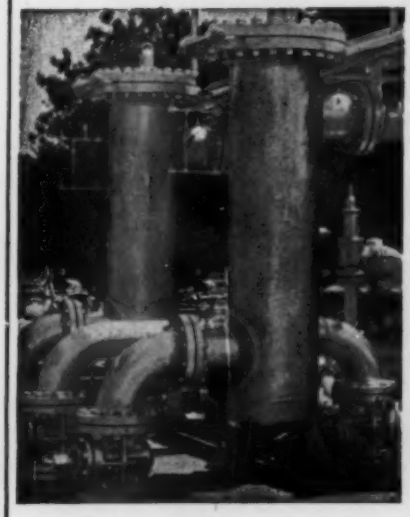
AN ESSENTIAL ACCESSORY

FOR ALL GAS PIPE LINE SYSTEMS



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Capacity — up to 34,000,000 standard cubic feet per day.

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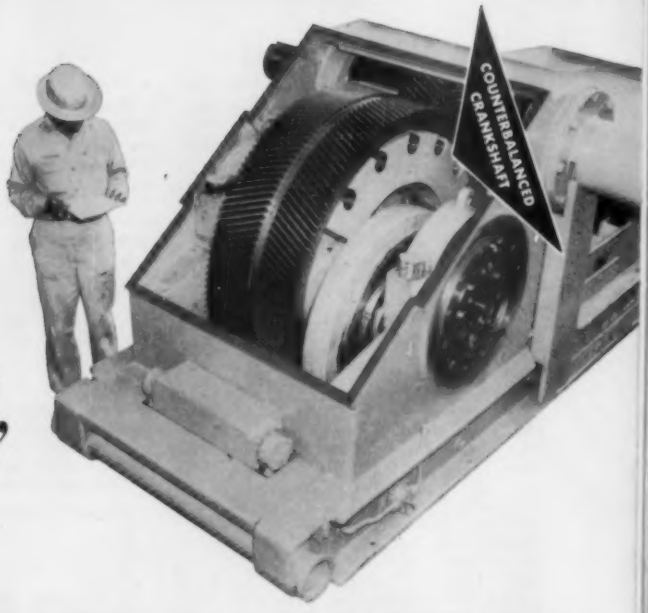
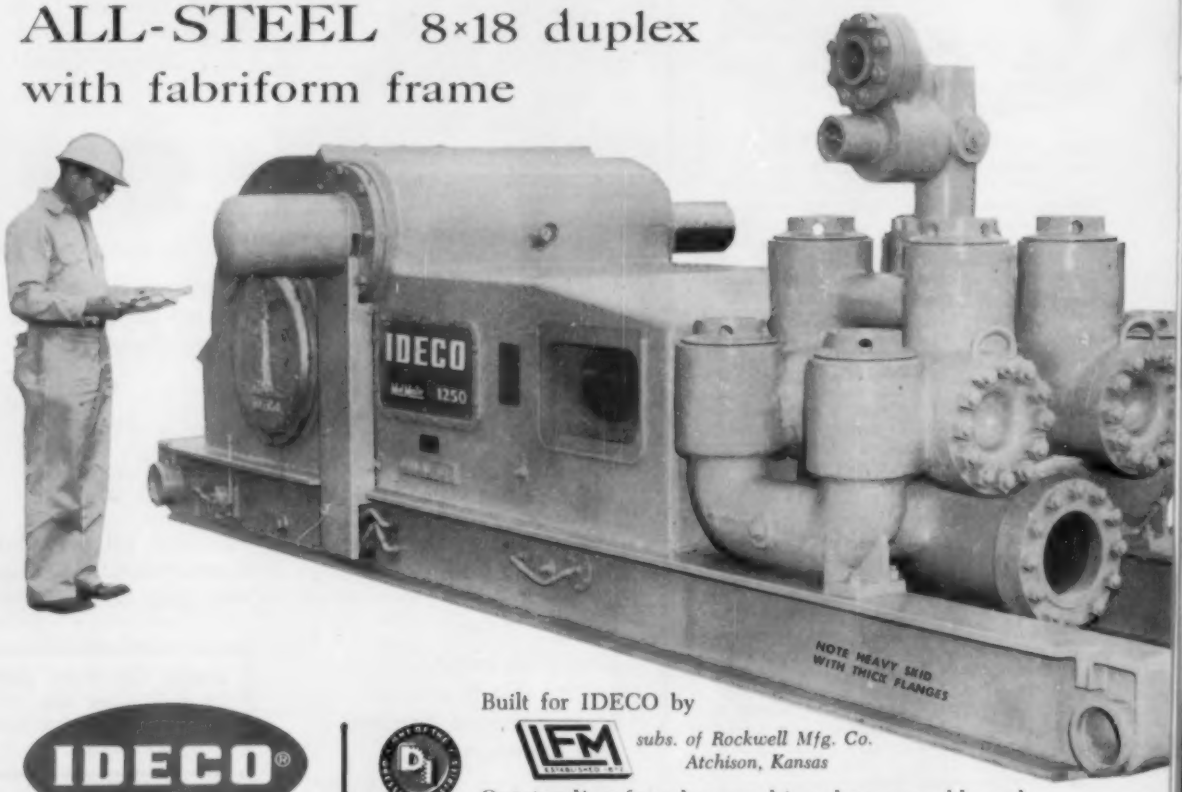


1250 h.p. MUD-MASTER

ALL-STEEL 8×18 duplex with fabriform frame



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Completely strain-gauge tested

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1250 h.p. is an ACTUAL RATING for this big Mud-Master — NOT A RE-RATING. Both dynamic and static strain gauge tests conclusively proved its design.

Fluid end tested to 9,000 p.s.i.

... 9,000 P.S.I. DISCHARGE SIDE; 4,500 P.S.I. SUCTION

One-piece cast steel fluid end has thick, high-strength walls around sweeping passages which eliminate eddies, give high volumetric efficiency.

2-piece threaded valve pot covers

... FEMALE THREADS ARE INTEGRAL WITH CASTING

Greater valve cover strength and quick removability is assured with Ideco's new 2-piece design. Union effect allows plug to compress packing without rotating.

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... ONLY 43.8 LBS. PER H.P.; 54,788 LBS. TOTAL

All-steel construction with fabriform frame and integral skid permits a strong, compact design with lowest weight per horsepower. Saves space and transportation cost.

Counterbalanced crankshaft

... SMOOTHS OUT PUMP OPERATION

Entire crankshaft assembly is precision counterbalanced for lower impact loading, smoother pump operation—a feature particularly important on barge and offshore installations.

Pressure lubricated throughout

... TWIN POWER END PUMPS MOUNTED OUTSIDE FRAME

Two separate pumps driven from the main gear deliver positive flush-out lubrication inside bearing races. Rods lubricated through inside of stuffing box glands.

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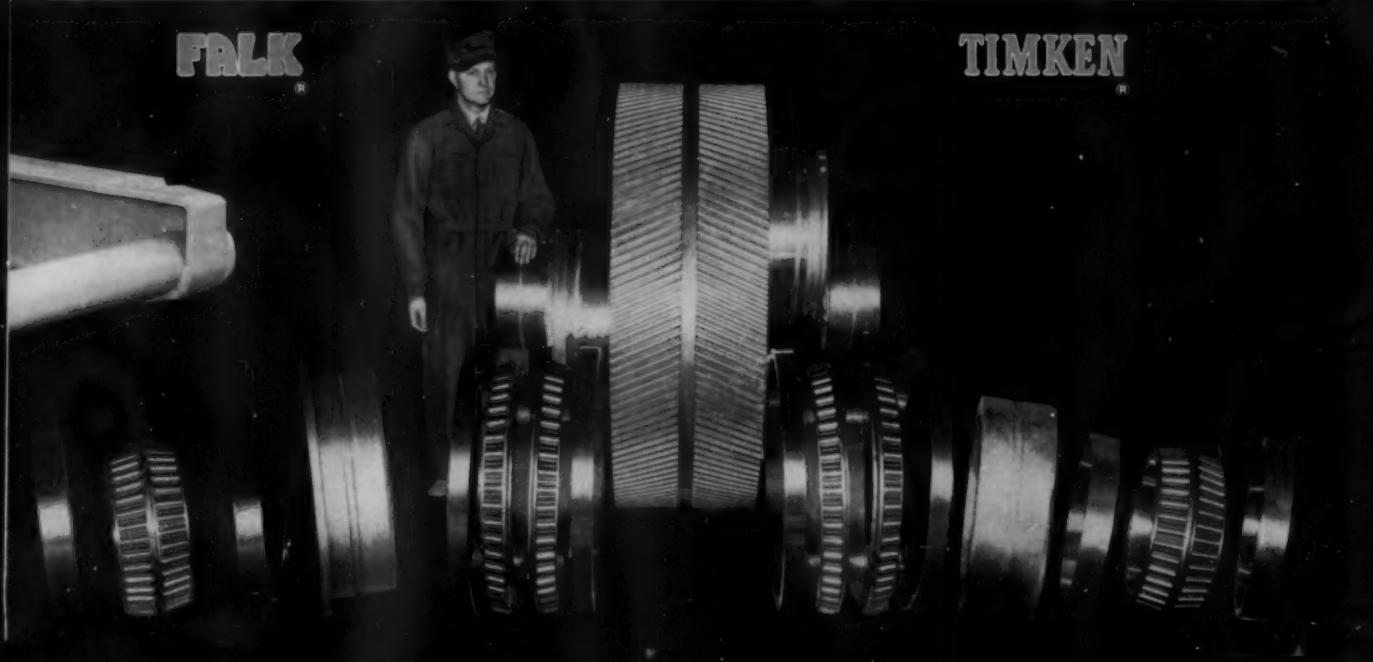
The flange-mounted main gear ring and the pinion shaft with its integral gear may be reversed for longer life. Gears are heat treated for maximum strength and toughness.

Timken double-row tapered bearings

... PRE-LOADED TO ELIMINATE BEARING SLAP

The crankshaft assembly is equipped throughout with high-capacity, long-life Timken double-row tapered bearings. Bearings may be hydraulically removed.



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Among the Drilling Contractors

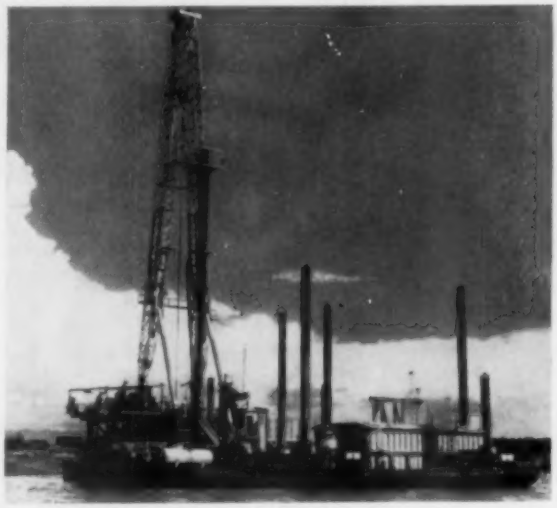
Louisiana Barge-Mounted Rig Drills in Lake Maracaibo

A BARGE-MOUNTED rig towed across the Gulf of Mexico from where it had been operated near the mouth of the Mississippi River is being used by Mene Grande Oil Co. in development along the Bolivar coast of Lake Maracaibo, Venezuela. On the Louisiana coast, it was operated by Gulf Refining Co. (now Gulf Oil Corp.)

In its first five wells in Lake Maracaibo, it drilled more than 22,000 ft. Deepest hole was 8,500 ft. The fifth well was completed early this month.

The barge was built, and the rig asbled, at Orange, Tex. It is 143 ft. long, 65 ft. wide, and 10 ft. deep, with a 12-ft. by 17-ft. slot in the front section for drilling. It is designed for use in water 4 ft. to 25 ft. deep. Hydraulic jacks on 10 caissons can raise it 10 ft. above water line.

Rig assembly is centered around a National 55 draw works. It is powered by 420-hp. General Motors engines.



DRILLING BARGE operated by Mene Grande Oil Co. in Lake Maracaibo, Venezuela.

It has a Type C-250 slush pump, and uses a 133-ft. mast.

Its deepest (8,500-ft.) hole was drilled with 4½-in. pipe with 22,000 lb. of drill collars.

Stickle Drilling Co., Tulsa, has a rig under contract to Sunray Mid-Continent Oil Co. for a 5,400-ft. Mississippian test 5 miles northeast of Plains field, in Meade County, southwestern Kansas. It will be drilled as 1 Winter. Spot location is in 26-31-30.

Arrow Drilling Co., Tulsa and Dallas, has a new wildcat operation going for Vickers Petroleum Co. in northeastern Beaver County, Oklahoma Panhandle. At 1 Dixon Unit, in 27-5n-26eCM, it is 2 miles southwest of Knowles. It is east of Mocane gas area. Contract is for a 7,200-ft. test.

Green & Dreblow Drilling Co. is on a projected 7,000-ft. test for McCulloch Oil Exploration Co. in the Helm-Lanare area, in Fresno County, Central California. Location is at 1 UC, in 14-17-18.

Woolf & Magee, Tyler, Tex., are drilling for Serio-Punches Oil Co., of Natchez, Miss., at a wildcat location midway between Church Hill and North Church Hill fields, in western Jefferson County, southwestern Mississippi. It is a Wilcox test to 5,700 ft. at 1 Guedon-Williams-Foster, in 25-9n-2w.

D & M Drilling Co. is contractor on a new Shamrock Oil & Gas Co. wildcat operation in eastern Seward County, southwestern Kansas. The test, 1-B Anthony, in 1-33s-31w, is 3 miles east of Kismet, and about 2½ miles northeast of Northwest Kismet pool. Contract is for 5,600 ft.

San Joaquin Drilling Co., Los Angeles, has the contract for a deep test Sunray Mid-Continent Oil Co. is starting to offset the Eocene discovery well being completed by L. A. Harnish in Guijarral Hills field, east of Coalinga, in Fresno County, California. Harnish's well, drilled by **K. L. Kellogg & Sons,** Compton, Calif., tested high-

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Only Weco has the precision-machined ball and cone seat that gives positive leak-proof protection, saving time and trouble on job after job. Only Weco has micro-machined Acme threads that make-up and break-out repeatedly without damage or distortion. Weco Unions are built to take the roughest service — and still maintain a perfect seal.

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WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS

WECO

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gravity oil in the 10,225-ft. Eocene sand. Sunray Mid-Continent's offset location is at E54 Allison, in 34-20-16. The new area is about 2 miles northwest of the Polvardero area, nearest Eocene production.

Field Drilling Co., San Antonio, is drilling on a 6,000-ft. wildcat test 12 miles north of Bruni, in eastern Webb County, Southwest Texas. It is a contract job for Argo Oil Corp. and Glen Mortimer, Jr., of San Antonio. The test is the operator's second on their Laredo National Bank lease, in Section 11, CCSD&RGNG Survey, Block 1.

Warren & Burdette, Inc., Houston, will drill a 10,500-ft. wildcat test 2½ miles east of the Melville area, in St. Landry Parish, South Louisiana. It is a contract operation for Anthony J. Tamborello, also of Houston. Permit listed the test as 1 M. W. Taylor with spot location in 26-4s-7e.

M. & M. Drilling Co., Houston, is getting started on an outpost test for South Bayou Mallet field, in northern Acadia Parish, South Louisiana. It is drilling for T. M. Evans, of Lafayette. Contract is for a 10,200-ft. test. Location is for 1 Link, in 36-7s-1e. It is slightly less than a mile south of production.

Southland Drilling Co., San Antonio, has a new contract operation in the Hoffman area, 7 miles south of Freer, in Duval County, Southwest Texas. Drilling is for Katz Oil Co., also of San Anonio, at 1 Sutherland, in Section 120, I. G. Sullivan Survey. Location is off the northwest flank of the field. Projected depth is 7,500 ft. Production in the field is from Government Wells and Loma Novia sands at 2,550 to 2,800 ft.

Penrod Drilling Co., Shreveport, is on a Phillips Petroleum Co. deep test in the North Shongaloo area, southern Columbia County, southern Arkansas. Drilling is set up to go to the Smackover about 11,400 ft. Location at 1-B Talley, in 1-20s-22w, is a mile northeast of North Shongaloo Pettet production, and about 2½ miles northwest of nearest Shackover production. The latter is in Red Rock field, across the state line in northern Webster Parish, Louisiana.

Hayes & Sprague, Inc., Los Angeles, has a deep test under way for Western Gulf Oil Co. in the Parallel area, west of Rio Bravo field, in northwestern Kern County, California. A 12,000-ft. test is planned. Location, at 1 CWOD, in 35-28-24, is just northeast of Buttonwillow.

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The New Model 412 Pressure Relief Valve

This new, improved Kinzbach Model 412 relief valve, for handling oil and heavier products at refineries and on pipelines, has a ball seated pilot valve. It is usually dead weight loaded, but can be spring loaded.

Among numerous advantages of this new valve are its dependable, positive action, with instantaneous opening and positive, automatic resealing. This is a simple, rugged valve easily tested that has high capacity and requires no pressure accumulation for full lift.

Available in 5 sizes, and four ratios in working pressures to 1000 p.s.i. Write for new catalog on all Kinzbach relief valves.

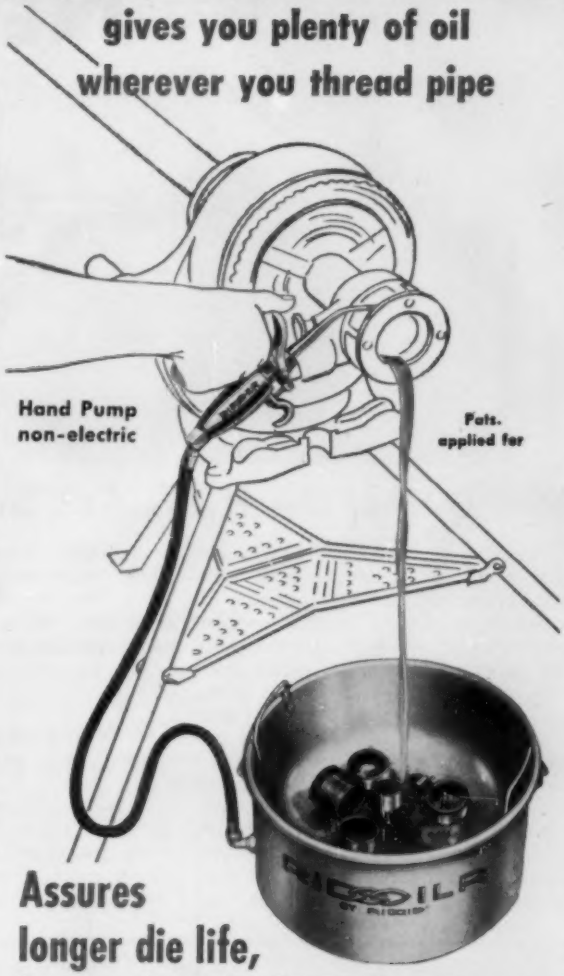
KINZBACH TOOL CO INC

Export Office: 74 Trinity Place, New York, N. Y.

KINZBACH TOOL CO., INC.; P. O. BOX 277, HOUSTON, TEXAS

Handy New Portable RIDGOILR

gives you plenty of oil wherever you thread pipe



Assures longer die life, better threads, big oil savings!

No wonder **RIDG-OILR** sales have soared... it lets you flood your threading dies cool wherever your work is, makes them cut better threads, last longer. Consists of screened chip-pan in circulating oil reservoir with hose-connected hand pump-gun, easy to operate—light to carry. Oil is double strained, used over and over. No messy floors. Quickly pays for itself—buy it at your Supply House!

The Ridge Tool Company • Elyria, Ohio, U.S.A.

RIDGID
Work-Saver Pipe Tools

SHOWCASE...

NEW EQUIPMENT

New Ditcher Has Hydraulic Controls

This Model 160 Gar Wood ladder type of ditcher is now equipped with new hydraulic controls, including a hydraulic boom hoist for fast, positive positioning of the boom, according to the maker. The boom is raised, lowered, and held by an independent, packaged type of hydraulic-control system —friction boom, clutch, or brakes are not required.

Double-acting hydraulic cylinders provide full crowd for the boom. The machine digs to a depth of 16 ft., with widths from 18 to 48 in. The shiftable boom allows the ditcher to work close to buildings, utility poles, streets, and obstructions. Reverse digging speeds allow undercutting of sidewalks and pipes. **Write or call: Gar Wood Industries, Inc., Wayne, Mich., for details on Model 160 ditcher.**

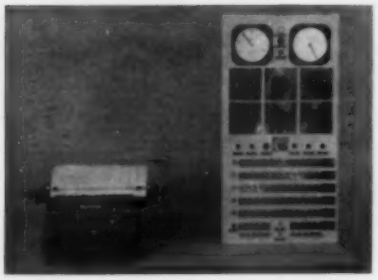
●

Oil-Well Pumps Handle 250 to 600 Bbl. Per Day

This new 450 series of Reda oil-well pumps is designed for wells producing from 250 to 600 bbl. per day. It includes pumps from 7½ to 20 hp. for well casings of 5½ in. or larger.

The pumps will lift fluids from depths of 900 to 4,400 ft. Fully automatic operation is available. Models of the pumps are available for operation from a 440, 762, or 880-volt power source. **Write or call: Reda Pump Co., Bartlesville, Okla., for details on Series 450 pumps.**

●



Datalogger Automatically Prints Tank Levels

This Datalogger, the latest addition to Telepulse equipment, will automatically log the liquid levels in large storage tanks each half hour with a ⅛-in. accuracy (1 part in 5,000 or better), the maker reports.

And when continuous-supervision alarm circuits warn of dangerously high or low levels, the Datalogger prints these data in red. Temperature, pressure, and other physical variables may also be logged. **Write or call: Shand & Jurs Co., 110 East Forty-second Street, N. Y. 17, N. Y., for details on Datalogger.**

●

Portable Calculator Weighs Only 3 Lb.

Providing capacities to 15 digits, this Produx-Multator Model 101 calculator can be used for multiplication, division, addition, and subtraction. It is equipped with: (1) back transfer, (2) setting levers in three colors, (3)

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

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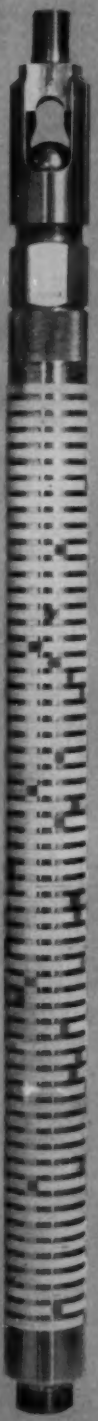
Metal to Metal Wear...

is the real villain in sucker rod pump troubles. It accounts for most of your repair and pump pulling expense.



The Martin Idea...

for getting away from this trouble has always been to make use of the best available materials — *Natural Rubber* for the key material in plunger rings; *Synthetic Rubber* for the key material in resilient ball guides for cages.

The accurately grooved and drilled metal body of **The Martin Plunger** does not touch the barrel. Only the resilient rubber and duck rings contact the barrel. This material — with its great natural resistance to abrasion as well as its slipperyness-when-wet — has a much slower wearing action on the barrel. Most often your barrel will not need replacing. These rings have an amazing ability to take the kind of abuse that goes with oil well pumping, and this means longer runs. Plunger cost is reduced because replacing the rings costs only about one fourth as much as a new plunger, and this saving is, of course, added to the barrel saving and longer runs.

Patent No. 2,591,174

The Martin Rubber Guide Cage protects the ball from all metal contact except when it rests upon its seat. The ball is protected to such an extent that ball and seat life is usually doubled. The synthetic ball guide and stop cannot beat out because of its resilience. Its life is therefore much greater than any metal and you get this longer cage life in addition to better ball and seat life. The two guides are easily replaced when the occasion does arise.

No real capital outlay is required to get these benefits because the cost of Martin Plungers and Martin Cages is very much the same as you are now spending for replacements — sometimes less.

All regular or stroke-thru ROD PUMPS and TUBING PUMPS can be equipped with Martin Plungers. Martin Rubber Guide Cages are made in all sizes and styles. Write for our catalog No. 4; also see Composite catalog for 1956-57.

JOHN N. MARTIN

Manufacturer

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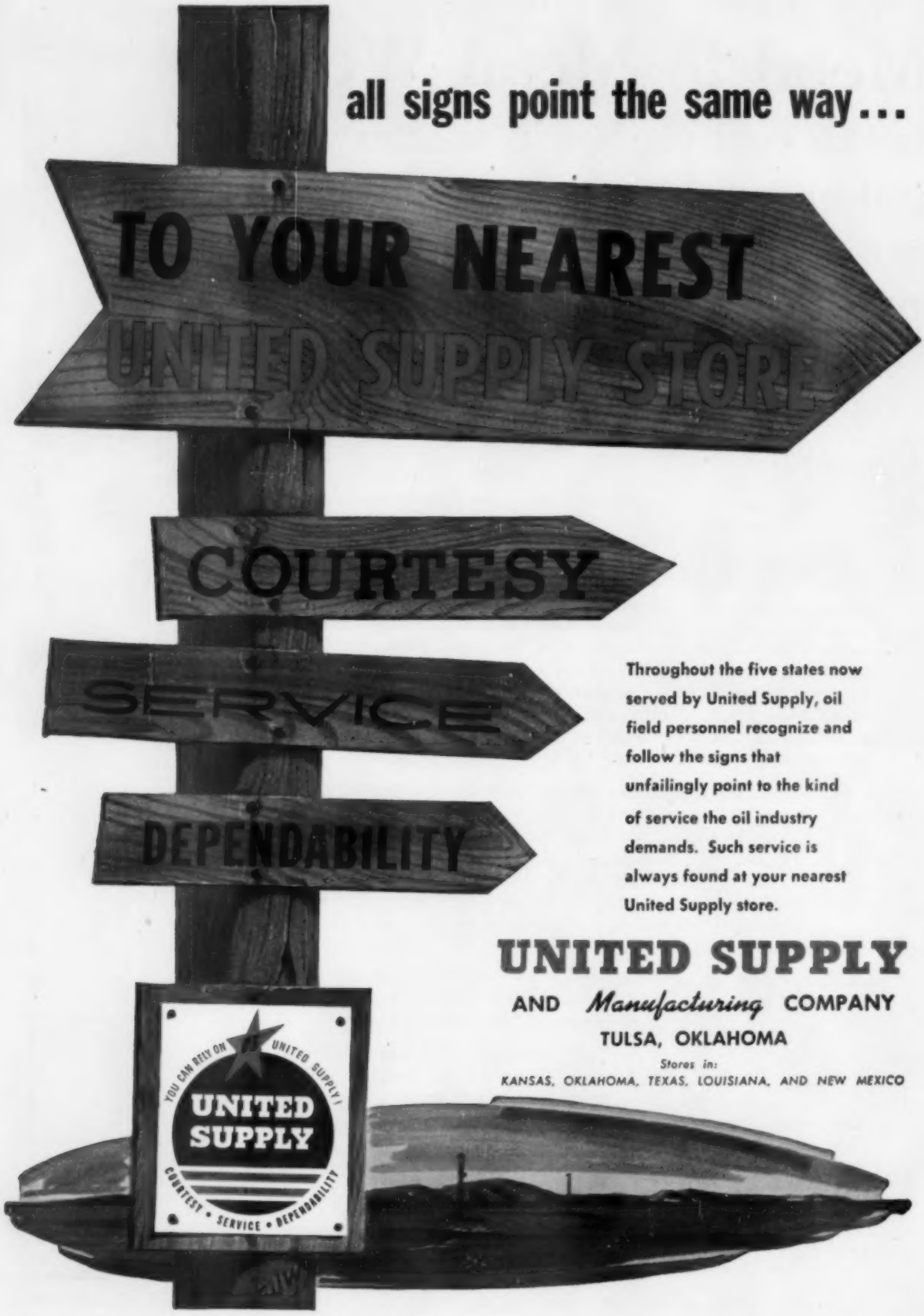
all signs point the same way...



Throughout the five states now served by United Supply, oil field personnel recognize and follow the signs that unfailingly point to the kind of service the oil industry demands. Such service is always found at your nearest United Supply store.

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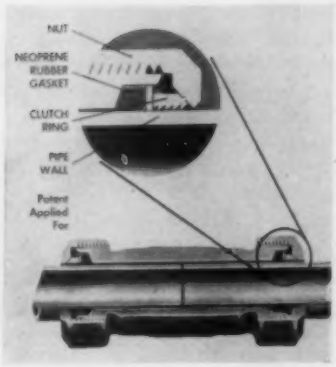
New Equipment

revolutions counter, cancellation knob, and (4) separation indicators.

Suction-cup feet hold the machine firmly in place. Sturdily constructed, it weighs only 3 lb. and measures 8¾ by 4¾ by 3½ in. A plastic cover and full instructions are included. **Write or call: Silver Bells, Ltd., 600 Sixteenth Street, Pacific Building, Oakland, Calif., for details on Produx-Multator calculator.**

●



Threadless Pipe Fittings Withstand 5,000 Psi.

This threadless pipe fitting will withstand traction forces of up to 3,600 lb. and hydrostatic pressures ranging from 450 psi. on 2-in. pipe to 5,000 psi. on ½-in. pipe, the maker reports. The fitting is factory assembled, ready for use in joining steel, wrought iron, or plastic pipe. No threading, grooving, flaring, soldering, or welding is necessary.

Tight gripping action is achieved through a brass clutch ring with inter-

Line Casing Offers Advantages for Deep Drilling

A valuable feature of this extreme line casing is its streamlined integral-joint design. Its interior and exterior contours are said to provide for maximum running efficiency in oil-well drilling. There are no shoulders to hang upon hole projections or to scrape mud seal from the walls of the hole.

The extreme line casing is able to withstand the high internal and external pressures of deep-well drilling, as well as the tensile stresses produced by the weight of long and heavy strings.

Other advantages cited for the casing are these: (1) the integral joint design reduces by half the number of threaded connections, (2) it gives positive resistance to leakage under the severe conditions encountered in deep-well drilling, (3) it gives a high joint strength, and (4) it has a small outside diameter.

The casing comes in a size range from 5 to 9⅝-in. o.d., inclusive; and in A.P.I. grades J-55, N-80, and P-110. **Write or call: Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa., for details on extreme line casing.**

Dense homogeneous structure with no moisture absorption

No practical current density limitation

Predictable low consumption rate

Virtually chemically and galvanically inert

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Everything points to

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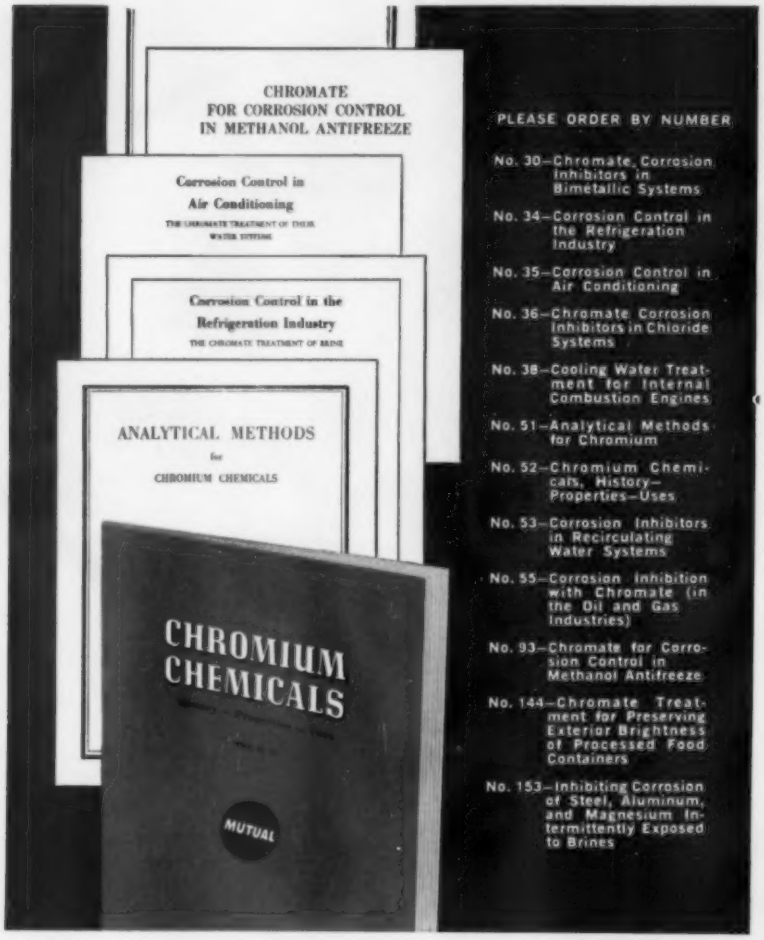
New Equipment

nal serrations which grip the pipe wall as the fitting nut is tightened. At the same time, a neoprene gasket is compressed against the pipe wall. Thus, a permanent seal against leakage of gas or liquid and resistance to abnormal vibration, contraction, or expansion is achieved. Socket ends and nuts are reamed slightly oversized to accommodate out-of-round and offtolerance pipe ends.

The Telsco fitting is available in couplings, adapters, 90° elbows, and tees. Applications include cuts into existing oil and gas piping and machinery and equipment lines.

The fitting is made from high-tensile-strength malleable iron to A.S.T.M. specifications. It is available in galvanized or Parkerized rustproof finish. Machined-brass stiffeners are available as accessory equipment for joining plastic pipe and tubes. **Write or call: Telsco Fittings Div., 5422 Redfield Street, Dallas, Tex., for details on threadless pipe fittings.**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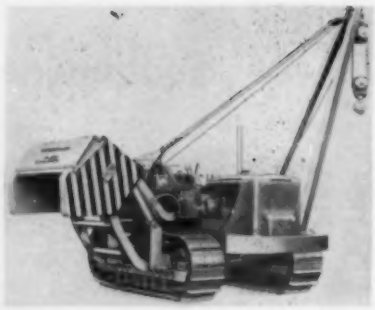


Medium-Size Pipelayer Has 86,000-Lb. Capacity

Designated the Caterpillar No. 572 pipelayer, this new medium-sized machine offers 86,000 lb. of lifting capacity at a 4-ft. overhang and an 86-in. wide track gage for dependable footing. Its ground clearance of 19 in. is said to assure maximum maneuverability in all types of terrain.

To withstand the extreme stresses of heavy pipelayer work, the machine's design includes integrated unit construction of the tractor chassis and pipelayer mechanism. Further weight carrying ability is provided by extra-heavy-duty track rollers—six on each side — having large-diameter bearings and shafts. A large sprocket, designed especially for pipelayer work, has also been incorporated. Hydraulic track adjusters permit quick adjustment of track tension.

Power for the pipelayer is supplied by a four-cylinder diesel engine, rated at 128 hp. at 1,200 r.p.m. The engine transmits power to a three-stage torque converter coupled with a special low-speed transmission having three forward and two reverse speeds. Inseat starting is provided by an independent two-cycle, four-stroke-cycle gasoline engine, with a 6-volt electric starter. **Write or call: Caterpillar Tractor Co., Peoria, Ill., for details on No. 572 pipelayer.**

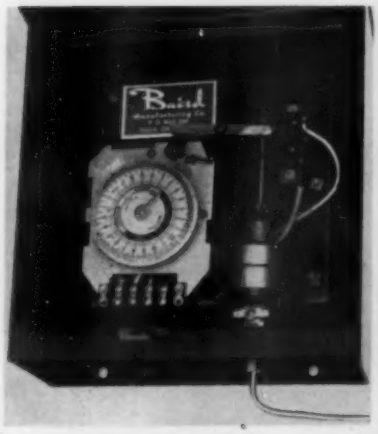
High-Tensile-Strength Pipe For Offshore Platform

This new heavy-duty pipe is produced especially for use in fabricating offshore drilling platforms. It is avail-

New Equipment

able in two sizes: 30-in., by 20-ft. lengths using ⅝-in. high-tensile-strength steel, and 33-in. by 20-ft. lengths using ½-in. high-tensile-strength steel.

Both sizes of the pipe are double jointed, using a continuous weld. **Write or call: Master Tank & Welding Co., 1612 Singleton Boulevard, Dallas, Tex., for details on pipe for offshore platforms.**



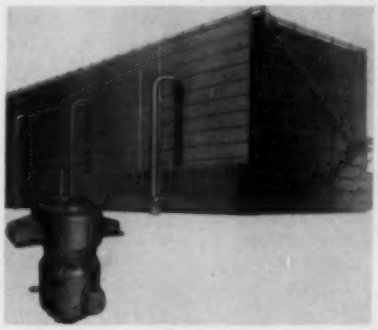
Pumper Shuts Down Well With Well Pressure

When a well is pumped off, this new Baird automatic pumper will automatically shut the well down (this automatic shutdown is controlled by the lead-line pressure from the well, not from a timing device). Then at any predetermined future time, the pumper will automatically start the well to pumping again.

Essentially the pumper consists of two diaphragm cases, two microswitches, a tripping mechanism, and a time clock. One diaphragm case mounts inside the control box and the other at the wellhead.

The control box for the automatic pumper can be mounted on any suitable bracket or pole away from the well. The diaphragm case in the control box connects by ¼-in. copper tubing with the other diaphragm case mounted at the wellhead.

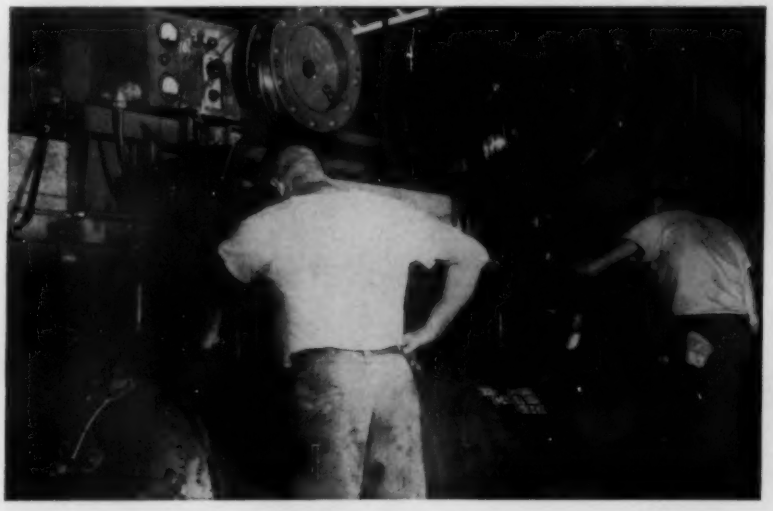
Simple pullout tabs inside the control box allow an operator to quickly set the desired starting time for the well. All that is necessary is to determine how many times a day the well is to be pumped. One tab is pushed down for each period. **Write or call: Baird Mfg. Co., Box 380, Tulsa, Okla., for details on automatic pumper.**



Cooling Tower Uses Special Vertical Gearmotor

One of the innovations used in this Galloway counterflow cooling tower is a new vertical gearmotor developed especially for cooling-tower service. The vertical gearmotor design is said to eliminate right-angle gear units, shafts, and flexible couplings.

The tower is built of nonleaching chemonited Douglas fir which gives a long life and resists the attack of



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SHOWCASE . . .

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fungus, according to the maker. The cooling tower has stainless-steel hardware for high corrosion resistance. All exterior sheathing is Douglas fir, chemically pressure-treated plywood sandwiched between two layers of plastic. **Write or call: G. W. Galloway Co., Cooling Tower Div., 220 South First Avenue, Arcadia, Calif., for details on cooling towers.**

Portable Instrument Detects Explosive Gases

Accumulations of explosive gases can be detected easily with this improved portable measurement instrument, called the Atlas Probetector. The Model 504 has been designed for use in petrochemical plants, refineries, and other places where there is a possibility for accumulation of explosive gases. Concentrations of gas below the lower explosive limit of the gaseous atmosphere in which the instrument's probe

is placed are registered on a direct-reading explosive meter.

The instrument is factory calibrated for methane and ethane gases. But it may be obtained with calibrations for other gases.

Housed in a compact weatherproof, rustproof metal case, the instrument operates on a 2-volt storage battery. A battery charger is provided with each unit. Operation is controlled at the instrument panel. **Write or call: Atlas Laboratories, Inc., P. O. Box 6247, Houston, Tex., for details on Model 504.**

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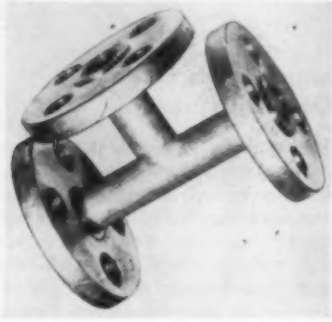


Insert Flange Speeds Process-Line Repair

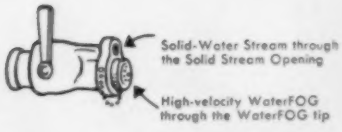
Maintenance and repairs to stainless-steel process piping, especially in hazardous areas, may be speeded up with this new Speedline insert flange. The flange is said to make it possible to tie in new equipment and break into existing lines and headers without resorting to welding.

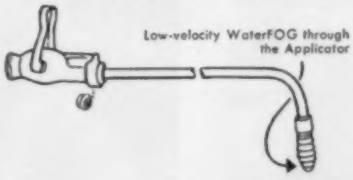
A press fit between the insert and the flange assures that the pipe or fitting can be expanded into the ferrule permanently, the maker says. And only one piece has to be handled. **Write or call: Horace T. Potts Co., Erie Avenue and D Street, Philadelphia 34, Pa., for details on insert flange.**

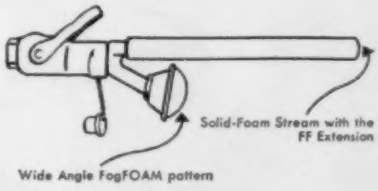
Rockwood SG-60 WaterFOG Nozzle is five nozzles in one

The lightweight Rockwood SG-60 WaterFOG Nozzle *eliminates "special" or single-purpose nozzles!* It actually does the work of five nozzles to put out fires faster, safer and more economically.

Here's what we mean . . .







Here's what you need to put out ordinary combustibles and flammable liquids . . .

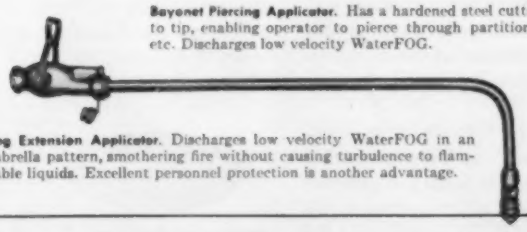
FOAM and "Wet" Eductor with the new FW Metering-Check Valve. Introduces Rockwood FOAM or "Wet" into hose lines, automatically proportioning correct amount of FOAM and "Wet" to water. Also usable wherever one liquid is fed into another on a fixed percentage basis.

Rockwood Double Strength FOAM. Puts out fires in flammable liquids, and in ordinary combustibles, quicker, at lower cost. Three parts FOAM and 97 parts water create a heat-resistant blanket.

Rockwood WET. One part WET mixed with 99 parts water increases water's penetration and extinguishing action. Gives quickest results against deep seated fires. Saves time, water, manpower.

FF Extension Unit. Shown with Type SG-60 Nozzle. Discharges Rockwood FOAM in a solid stream or as Fog-FOAM. Wide angle makes it possible to cover large areas at one time.

Bayonet Piercing Applicator. Has a hardened steel cutting tool attached to tip, enabling operator to pierce through partitions, into interiors, etc. Discharges low velocity WaterFOG.



Long Extension Applicator. Discharges low velocity WaterFOG in an umbrella pattern, smothering fire without causing turbulence to flammable liquids. Excellent personnel protection is another advantage.

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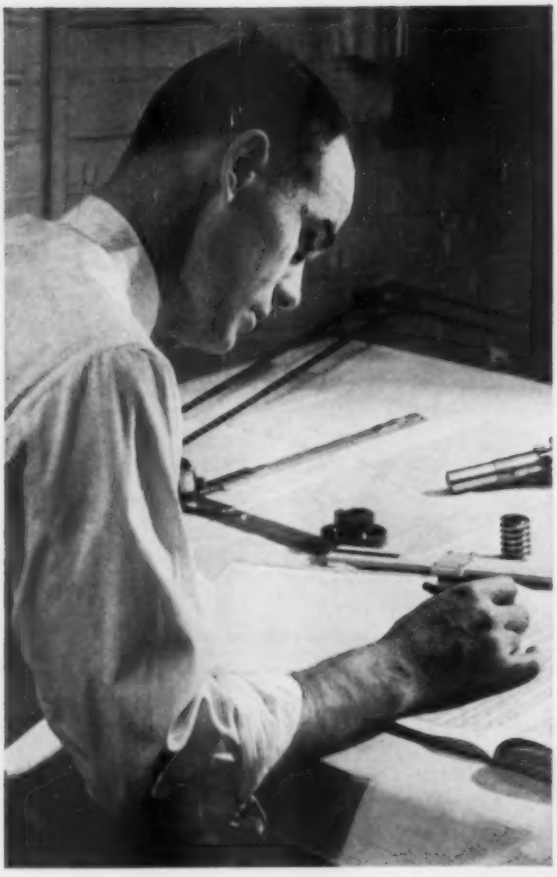

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Twin Disc Friction Clutches and Power Take-Offs are backed solidly by the largest parts and service network of its kind . . . to assure you prompt repair and parts replacement if ever needed . . . no matter where your oilfield equipment operates.

Twin Disc maintains 7 Factory Branches, with 68 Parts Stations and 89 Authorized Hydraulic Dealers (see oilfield listing in adjoining column) . . . plus parts stocks at thousands of dealers handling oilfield and other industrial equipment.

Twin Disc's extensive parts and service network is one of the reasons why Twin Disc products have been the preference of engine and oilfield equipment manufacturers for more years, on the widest variety of applications, than any other make of friction or fluid drive for industrial use. This service not only protects the over-all performance of the manufacturer's product—*it protects the user in the field.*

There's little wonder that Twin Disc is known and recommended throughout the oilfields . . . known for service it has given customers for almost 40 years . . . recommended for the quality and long life of its products.

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Twin Disc Clutch Company, Racine, Wisconsin; Hydraulic Division, Rockford, Illinois.

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Denver: Industrial Equipment Company, 4999 Jackson St.

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Carmi: Diesel Accessories & Engineering Company, P. O. Box 372.

KANSAS

Great Bend: Scheufler Supply Company, 1515 Kansas Ave.; and Kansas Engine & Machinery Co., Inc., P. O. Box 2.

Wichita: Kansas Engine & Machinery Co., Inc., 2915 Southwest Blvd.; P. O. Box 3404, Westside Station.

LOUISIANA

Berwick: Sewart Supply, Inc., P. O. Drawer 108.

New Orleans: Rogers Diesel Engineering Company, Inc., 2648 Paydras St.

Shreveport: Bearing & Transmission Company, 214 Market St., North.

NEW MEXICO

Hobbs: Vance Supply Company, 211 S. Grimes St.; P. O. Box 1286.

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Duncan: Hopeman Equipment Company, Inc., 211 East Main St.; P. O. Box 1152.

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Seminole: Hopeman Equipment Company, Inc., 102 Main Street; P. O. Box 1339.

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Kilgore: Jack Anderson Engine Company, 100 Industrial Blvd.; P. O. Box 1290.

Odessa: Vance Supply Company, 115 E. First St.

San Antonio: Midcap Bearing Service, 605 N. Main Ave.

Wichita Falls: Pearce Sales & Service, Incorporated, 218 Indiana St.

WYOMING

Casper: Emrick & Hill Engine & Equipment Co., 1701 E. Yellowstone; P. O. Box 2290.

CANADA

Alberta, Edmonton: Wilson Equipment Company, Ltd., 7011 104th St.

Twin Disc Factory Branches

Dallas: 1511 Turtle Creek Boulevard, Riverside 3014.

Tulsa: Enterprise Building, Sixth and Boston, Gibson 7-1578.

Los Angeles: 2950 Leonis Boulevard, LOgan 8-3309.

SHOWCASE . . .

New Literature

Plastic-Coated Pipe and Tubing, their advantages and general properties are discussed in this new four-page folder. Describing the problems of pipeline corrosion, it shows how the strength of steel and the protection of plastic have been combined in a product to meet the requirements of severe corrosive applications. **Write or call: Republic Steel Corp., 3100 East Forty-fifth Street, Cleveland 27, Ohio, for folder on plastic-coated pipe and tubing.**

●

Soil Testing Manual. Unconfined compression tests for cohesive soils are described in detail in this new 56-page testing manual. The manual outlines standard engineering test procedures using laboratory equipment especially designed for performing soil compression tests. Written for engineering, laboratory, and educational instruction use, the manual deals with the interpretation, application, and limitations of the test data obtained as well as with procedures and testing equipment. **Write or call: Soiltest Inc., 4711 W. North Avenue, Chicago 39, Ill., for copy of "Soil Testing Manual."**

●

Gage Accessories. Bulletin 600 (four pages) describes accessories for gages, dial thermometers, and recorders. These accessories include attachments for protection of the instrument internals against corrosive media, pulsations, and pressures. The bulletin also shows a ring by which turret-case instruments can be panel-mounted together with other tools and fittings used in instrument operation. **Write or call: United States Gage, Div. of American Machine & Metals, Inc., Sellersville, Pa., for Bulletin 600.**

●

Chemicals and Petroleum. This new and valuable 16-page directory gives the names of plants, refineries, production companies, and related industries of petroleum in and around New Orleans and the Gulf Coast areas. **Write or call: National Bank of Commerce, New Orleans, La., for copy of "Chemicals and Petroleum Directory."**

●

Low-Pressure Regulators with connection sizes from ¾ to 6 in. for gas engines and similar gas-consuming equipment are the subject of revised Bulletin 1044, Rev. 6. It contains revised size, capacity, and weight tables necessitated by doubling of the maximum

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inlet pressure of Rockwell 120 regulators. Capacity tables make allowance for the fact that capacity is not limited to the amount of gas passed at a 1 psi. inlet-outlet differential. The bulletin points out that differentials up to 10 psi. may be used—provided the control tube is taken downstream. Diagrams illustrate the operation, dimensions, and special applications of the regulator. **Write or call: Meter and Valve Div., Rockwell Mfg. Co., 400 North Lexington Avenue, Pittsburgh 8, Pa., for Bulletin 1044, Rev. 6.**

●

How to Select a Fire Extinguisher. This new chart lists the basic types of extinguishers and shows at a glance which to use against these three classes of fire: Class A—wood, paper, rubbish, etc.; Class B — volatile liquids; and Class C—electrical fires. It explains the effects of temperature, the operating ranges for each type of extinguisher, and how various extinguishing agents kill fire. And it provides other helpful information on extinguishers. **Write or call: Fire Equipment Mfg. Association, Inc., Suite 759, One Gateway Center, Pittsburgh 22, Pa., for chart "How to Select a Fire Extinguisher."**

●

Flexible Connectors Bulletin 158 offers information on how to absorb vibration, dampen noise, reduce piping failure, and prevent leakage. It gives material specifications, pipe sizes, and fitting connections as well as operating pressures and maximum offset allowed. A diagram shows proper installation procedures. **Write or call: Flexonics Corp., 1345 South Third Avenue, Maywood, Ill., for Bulletin 158.**

●

Industrial Power Units. This new 19-page catalog covers a line of power units for all types of industrial applications. It gives specifications, diagrams, and photographs on 31 engine models ranging from 44 to 761 b.hp., including a new six-cylinder engine. **Write or call: Detroit Diesel Engine Div., General Motors Corp., Detroit 28, Mich., for catalog "Industrial Power Units."**

●

Cooling Tower and Heat Exchanger Fans is the subject of eight-page revised Bulletin A-111B. The bulletin supplies descriptions, specifications, and performance data on fans with aluminum-alloy blades in diameters from 40 to 132 in. and with plastic blades in diameters from 10 to 22 ft. It also includes detailed data and a schematic diagram of a controllable-pitch heat-

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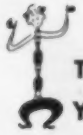

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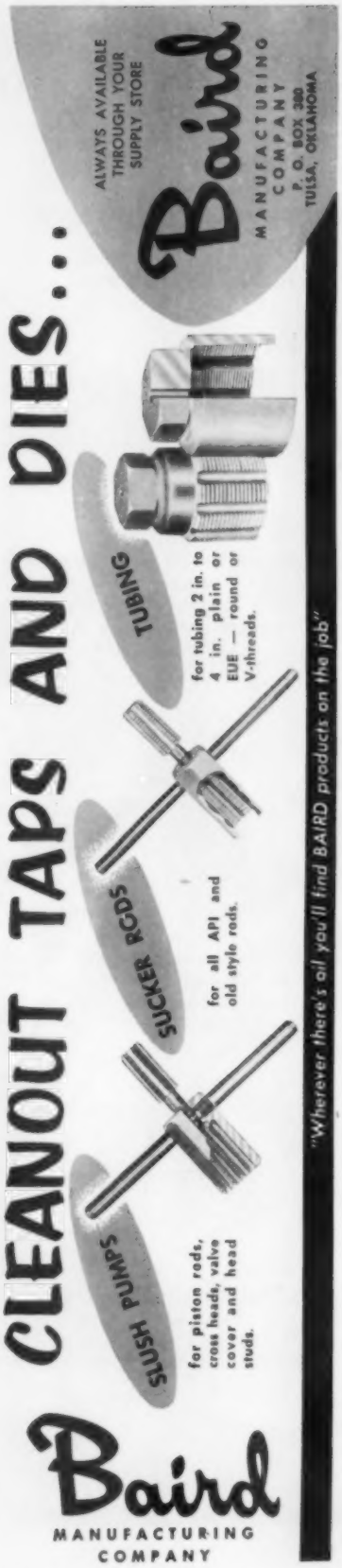
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exchanger fan. **Write or call: Hartzell Propeller Fan Co., Piqua, Ohio, for Bulletin A-111B.**

•

Corrosion Guide for Process Equipment. Ten pages of tables in this new 12-page brochure list over 500 corrosive media and recommend materials suitable for use in equipment subject to corrosion from the chemicals and chemical processes listed. The comprehensive guide is designed to be of value in determining the types of corrosion-resisting metals to consider in processing equipment subject to chemical corrosion. **Write or call: Misco Fabricators, Inc., 2420 Wills Avenue, Marysville, Mich., for "Corrosion Guide."**

•

Motor Control Centers. This 12-page booklet pictures and describes Nelson motor-control centers which have three types of wiring—N.E.M.A. Type A without terminal blocks; N.E.M.A. Type B with terminal blocks in individual units; and N.E.M.A. Type C which are completely wired to master terminal blocks. Schematic diagrams show basic structure designs, foundation plans and layout of conduit opening space, and three different wiring setups for the control center. The booklet also contains charts which give the space requirements for the units. **Write or call: Nelson Electric Mfg. Co., 4041 South Sheridan Road, Tulsa, Okla., for booklet, "Motor Control Centers."**

•

Oil-Field Specialty Tools. Punched for filing, this new 76-page catalog covers the oil-field specialty tools manufactured by Bowen-Itco. These tools, illustrated by sectional drawings, include blowout preventers, jars, overshots, wire-line equipment, spears, weight indicators, and wellhead assembly components. The catalog supplies information on the use, operation, assembly, and maintenance of the tools. It also furnishes complete parts and price lists. **Write or call: Bowen-Itco, P. O. Box 4587, Houston 13, Tex., for catalog on oil-field specialty tools.**

•

Drill-Collar Stabilizers, their use, and application are described in this informative 16-page booklet. The booklet includes descriptions and illustrations explaining: (1) both stiff bottom-hole and pendulum types of hookup, (2) how to avoid sticking in a deflected hole, (3) how to reduce drill-string torque, and (4) the use of stabilizers as a fulcrum in deflected holes. Tables list the common types of stabilizers, their characteristics, and application under different formation, hole, and string conditions. The information, written in simple, nontechnical terms, is based on the findings of several authorities in the field. **Write or call: Grant Oil Tool Co., 2042 East Vernon Avenue, Los Angeles 58, Calif., for booklet, "The Use and Application of Drill Collar Stabilizers."**

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EQUIPMENT MEN . . . in the News

Hughes Tool Names Mathis As Illinois Division Manager

J. H. MATHIS

Appointment of Joseph H. Mathis as manager of the Illinois division has been announced by W. L. Hunter, Hughes Tool Co.'s northern regional manager.

Mathis started with Hughes Tool Co. as office manager at Clay City, Ill., in 1938 and prior to his present appointment was Illinois district manager for 11 years.

Mathis replaces Irving H. Bettis who retired after 30 years of service. Bettis joined the Hughes engineering department in Houston in 1927 and continued in field engineering until 1945 when he transferred from engineering to sales and was made manager of the Illinois division.

Mission Announces Details Of Plant, Office Facility

Mission Manufacturing Co. has begun construction of its new $2.25-million plant in Houston, one which is designed to give the utmost in production efficiency, W. Bedford Sharp, Mission president and chairman of the board, has announced. Completion date is set for March 1958.

In releasing details of the far-reaching Mission expansion program, Sharp emphasized that the installation is designed for minimum material handling and maximum modern features.

Operation-wise, automation features will be unusual. The main building will make extensive use of brick and aluminum siding. It will be windowless and fully air-conditioned. Location of the project is on a 72-acre tract on Clay Road.

The production will contain 150,000 sq. ft. A mezzanine will make available 7,500 sq. ft. Plans for the office building, containing 45,000 sq. ft., are now being drawn and an announcement will be made soon regarding it.

Complete engineering research and test facilities will be included. Although the new facilities represent a big expansion step for Mission, the company designed the plant with allowances for even further expansion in the future.

Brown & Root designed the installation, and supervising architects are Zimmerman & Bible. General contractor is W. S. Bellows, mechanical contractor is Barber, Inc., and electric work will be by Copeland Electric Co. Gulf Automatic Sprinkler Co. will install sprinklers throughout the plant and the railroad spur will be built by W. A. Smith Co.

Oilwell Appoints Cayan to Sales Post, Transfers Ruhl

The appointment of John G. Cayan as oil-field sales representative for eastern area of United States Steel Corp.'s Oil Well Supply Division has been announced by K. O. Nilsson, general manager of the division's Witte Engine Works. Cayan will be located at Kansas City, Mo.

Donald P. Ruhl, field representative, has been transferred from Casper, Wyo., to Farmington, N. M., according to R. L. Armstrong, Rocky Mountain area manager of the division.

Prior to his employment with Oilwell, Cayan had 12 years of engineering experience. Ruhl was employed at Fort Morgan, Colo., in 1955 by Oilwell and was named field representative at Casper in February 1957.

Halliburton Honors Thornton's Long Service

J. D. Thornton's two decades with Halliburton Oil Well Cementing Co., most of it in foreign service, was recognized recently when Ralph R. Emery, left, Halliburton's vice president for foreign operations and export sales, gave Thornton a 20-year service pin, as R. G. Kelly, senior vice president, looks on. Since 1941 Thornton has worked in Venezuela, Colombia, Canada, Mexico, West Germany, Saudi Arabia and the Kuwait Neutral Zone.

Byron Jackson Tools Opens Corpus Christi Office

To expand their services to the oil industry in the South Texas area, Byron Jackson Tools, Inc., has created an office-warehouse at Corpus Christi, according to V. C. Horner, vice president and manager of sales.

The new facilities were erected to BJ specifications to make the warehouse and sales office almost self-sufficient in providing quick service to contractors and operators in the area.

The new office will be managed by R. L. Patton under the direction of C. F. Vincent, regional sales manager. Byron Jackson closed its Alice, Tex., office in March.

Schlumberger Appoints Managers and Engineers

W. J. BOWEN

W. J. Bowen has been promoted to manager of Schlumberger Well Surveying Corp.'s Northeast division at Evansville, Ind. Prior to his promotion, Bowen was assistant manager of the Louisiana Coast division at Layafette, La.

New district managers are T. C. Nichols at New Iberia, La.; G. F. Chambliss at Cortez, Colo.; George Broussard at Franklin, La.; and J. M. Price at Ardmore, Okla.

New division sales engineer for the Louisiana Coast division with headquarters in Lafayette is A. Perez.

D. W. Stinger is now senior sales engineer at Duncan, Okla. W. L. Boeken has been appointed sales engineer for the Shawnee, Okla., district, and F. M. Mullins assumes the same position at New Iberia.

RCA Appoints Daly as East Coast Sales Representative

Appointment of F. T. Daly as East Coast and Southeast sales representative for RCA microwave equipment and systems has been announced by E. J. Hart, microwave equipment sales manager, communications products department, Radio Corp. of America.

Daly, formerly marketing and sales analyst for microwave equipment at the department's Camden, N. J., home office, succeeds L. R. Vincent, who

recently was appointed to a sales post with RCA's West Coast electronic products department, Los Angeles.

Hart also announced that F. H. Long will succeed Daly as microwave marketing and sales analyst.

Daly has had 10 years of engineering and sales experience with RCA Service Co., and the RCA communications products department. Long, who joined RCA in 1947, for the past 4 years has been branch manager in Lancaster, Pa., for the RCA Service Co.

Tretolite Reorganizes and Expands Sales Staff

Tretolite Co., division of Petrolite Corp., has reorganized and expanded its sales and service staff. Two new

J. B. ROBINSON

J. L. HAMPTON

service divisions have been created. One, the northwestern, will comprise western Kansas and Oklahoma and the Texas Panhandle area. J. B. Robinson, formerly assistant manager for the northern division, will be manager. He will make Great Bend, Kans., his headquarters; his assistant manager will be H. R. Land.

The other division will be known as the West Central and will take in West Texas and New Mexico. It will be managed by J. L. Hampton, formerly manager of the Rocky Mountain division. His assistant manager will be R. Q. Hughes. They will have headquarters at Midland, Tex.

L. C. DESSERT

L. A. BAINTER

The Rocky Mountain division will now be managed by L. C. Dessert, with R. O. Byron and John Stewart as assistants. Dessert was formerly with the home office district of Tretolite Co. as assistant chief chemist. His headquarters will be Casper, Wyo.

The southern division, comprising the Texas-Louisiana Gulf Coast area, will be supervised by L. A. Bainter, Jr., with O. L. Bassham, P. R. Donnelly and W. M. Robertson as assistants. Bainter will make Houston his headquarters. C. C. Rogers, Jr., former manager, has moved to a special assignment with Petrolite Corp. San Antonio, Tex., will be his headquarters.

Harry S. Horton, with headquarters at Tulsa, and M. J. Mullally, with headquarters at Dallas, Tex., will continue to supervise the northern and Central divisions, respectively.

American Marine Finishes Supply Vessel for Tidewater

Another offshore supply vessel built by American Marine Corp. completed trial runs recently and was accepted by its owner, Tidewater Barges, Inc., New Orleans. The 136-ft. Don Tide is the seventh vessel built by American Marine for Tidewater. Three additional vessels are under construction at present.

Present for the trial run were: Donald Durant, in whose honor the boat was named, member of the board of directors of Tidewater Marine Service; John Laborde, president of Tidewater Marine; and Walter Michel, assistant vice president of American Marine.

The Don Tide has about 2,800 sq. ft. of open-deck cargo space designed to carry drilling equipment to offshore drilling barges and platforms. The vessel has a 32-ft. molded beam and a 9-ft. 1-in. molded depth.

Grant Oil Tool Will Enlarge Plant and Offices

Grant Oil Tool Co. has broken ground for an enlargement of its main plant and offices in Los Angeles. The new building will more than double existing floor space and provide increased production and testing facilities for the Grant line of drilling tools. Grant manufactures reaming, stabilizing and hole-conditioning equipment.

Lane-Wells Makes Personnel And Location Changes

Ernest Snidle has been transferred from Mount Carmel, Ill., to Olney as area manager. O. T. Bright is now sales engineer at that location. In the Kansas district Maynard E. Weber has been reclassified to district sales engineer trainee at Guymon, Okla., replacing Roy Smith who is now field service operator.

Lindsey B. Johnson, district logging engineer at Oklahoma City, has been reclassified to district sales engineer and transferred to Perry. Jimmy L. Baker and K. W. Simmons are sales engineers at Duncan, Okla., and Pawhuska, Okla.

In the Rocky Mountain district Arthur L. Miller has been reclassified to field service operating engineer in charge at the Sterling, Colo., truck station. Claude I. Morris, formerly field service operator in the Kansas district, was transferred to Williston, N. D., as district logging engineer for the Williston district. The Glendive area has been reclassified as a truck station. Robert L. Westall, operator in charge at Roundup, Mont., was transferred to Glendive as field service operating engineer in charge.

Mid-States Named Breaxit And Corexit Distributor

Mid-States Chemical Co., Inc., Mount Vernon, Ill., has been appointed distributor for Humble Oil & Refining Co.'s oil-field chemicals called Breaxit and Corexit. Mid-States expects to be warehousing and servicing other Humble products soon.

Mitchell L. Forrester, formerly of The Texas Co. producing department, has joined the firm as service engineer for the Humble products. Forrester has been training at the Humble laboratory in Houston and with the company's field engineers in Louisiana and Mississippi.

Mid-States' service will consist of a completely equipped laboratory mounted in a station wagon for on-the-job service and testing.

Magcobar Names Industrial Products District Managers

R. L. SNOOK

Robert L. Snook, Gerry Morrical and H. M. Gwyn, Jr., have been appointed to the newly created positions of district managers of the industrial products department of Magnet Cove Barium Corp., according to George H. Moore, sales manager, industrial department.

Snook, formerly sales representative,

G. MORRICAL

H. M. GWYN, JR.

is southwestern district manager. Morrical, formerly sales representative, was appointed midwestern district manager. Gwyn joins the department from Minerals & Chemicals Corp. as eastern district manager.

Snook was chief chemist and plant manager for Acock Laboratories, Ltd., prior to joining Magcobar in February 1956. Morrical served with Dodge Manufacturing, and Oliver Corp. prior to joining Magcobar in 1954. For over 20 years Gwyn was with Attapulgus Clay Co. and its successor, Mineral & Chemicals Corp., of America, in sales and technical service capacity.

Hills-McCanna Appoints Gulf Supply as Distributor

Gulf Supply Co., Inc., has been named as an exclusive stocking distributor for Hills-McCanna Co.'s diaphragm valves and replacement parts in western Louisiana and central and eastern Texas.

Gulf Supply maintains distributing points at Beaumont, Corpus Christi, Dallas, and Houston, Tex., and Lake Charles and Shreveport, La.

Mason-Neilan Sets Up New Sales Post and Offices

A. Blair Powell has been named to the new post of general sales manager by Mason-Neilan, division of Worthington Corp., according to Carl W. Gram, Jr., vice president.

Three new regional sales offices have been established by Mason-Neilan. Warren F. Priest is appointed eastern regional manager supervising Boston, Buffalo, New York, Skaneateles, Philadelphia and Pittsburgh offices. E. Putnam Head becomes southeastern regional manager supervising Atlanta, Birmingham, Charlotte and Jacksonville offices, and Alex M. Thackara is promoted to West Coast regional manager supervising the Los Angeles, San Francisco, Seattle, Denver, Salt Lake, El Paso and Phoenix offices. In addition Malcolm D. Duncan has been appointed manager of a new Jacksonville office.

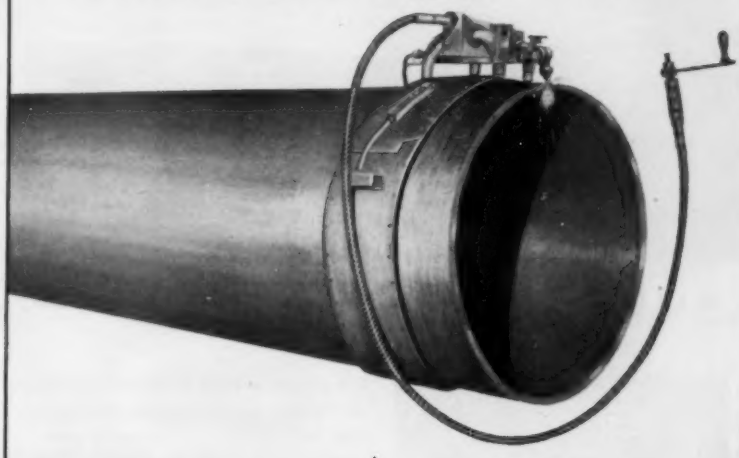
Hawkeye Opens New Branch, Adds Representatives

The designation of a new branch office in Houston and the addition of three district representatives for Hawkeye Products Corp. of Syracuse, N. Y., have been announced by Hawkeye's president, James Bentley. The new offices will service seven states including Texas, Louisiana, Oklahoma, Ohio, Michigan, Pennsylvania, and New Jersey.

The branch office serves the Gulf Coast area and is under the supervi-

BEVELS 6" PIPE

BEVELS 48" PIPE



C-R-C IMCO BEVELERS

fit all pipe sizes 6" to 48" O. D., cut perfect bevels, and out-of-round pipe, too. Single lightweight unit does work of several, costs you less to buy and use.

ONE BEVELING KIT FOR ALL YOUR JOBS!

The CRC IMCO Pipe Beveling Kit contains a complete range of bands for beveling a variety of pipe sizes. With this convenient selection of sizes, the operator need only make one trip to handle all pipe beveling requirements including back beveling. The sturdy steel case and number of bands are optional.

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sion of E. K. Graham, Jr., district manager.

Gallagher Industrial Equipment Co. is Hawkeye's district representative in the Philadelphia, Pa., area. Robert A. Shuey, Jr., will act as agent in Dallas and Farnworth-Johnson Corp. will act in that capacity in Detroit, Mich.

Ferguson Joins Houston Office of Harold Brown

Paul Ferguson has joined Harold Brown Co., Inc., in the Houston office, where he will do sales and service work. Ferguson was formerly with Otis Pressure Control, Inc.

Otis Announces New Sales Department Assignments

Robert McAmis has been transferred from Otis Pressure Control, Inc.'s, division office in Houston to Harvey, La., as district superintendent. He will have offices in the Rathborne Building. Raymond Herbert has been transferred from Houma to a newly established office in New Orleans. He will replace Jack Russell who has been transferred to the firm's Odessa, Tex., division headquarters.

The new division offices in New Orleans are located in the America Fore Insurance Co. Building. Bill Hill, division manager for the southern Louisiana area, will move his offices from New Iberia to New Orleans. He has also been stationed in Otis' branches in Hobbs, Houston, Odessa, and Corpus Christi.

John Prejean has been promoted from office manager in the firm's Corpus Christi division to sales representative. He will remain in Corpus Christi.

Joe Rosson has been transferred to Houston as a sales engineer. He was previously assigned to the company's New Iberia division.

Bill Mitchell has been transferred from Odessa to New Iberia as district superintendent.

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Continental-Emsco Names Export Representative

G. W. BASQUEZ

George W. Basquez has been appointed export representative by Continental-Emsco Co. He will also be in charge of the Houston and Southwest export operations. Basquez will headquarter at Continental-Emsco's Houston export office in the Esperson Building.

Basquez was formerly a drilling-equipment specialist assigned to the Houston division. He joined Continental-Emsco in 1946.

The Houston export office operates under the direct supervision of Continental-Emsco's New York export division, of which H. E. Lowrey is manager.

Arnold Pipe Rentals Will Expand Into Louisiana

Arnold Pipe Rentals Co., Inc., Corpus Christi oil-field equipment rental firm, with yards in Victoria and Edinburg, soon will expand operations into South Louisiana and offshore according to E. P. Arnold, president. A new equipment yard and warehouse will be established in Morgan City, La.

Fish Northwest Constructors, Inc., an affiliate of Fish Engineering Corp., Houston, recently acquired 80 per cent interest in the Arnold company and plans to purchase additional pipe and equipment as well as establish new service locations.

Arnold Pipe Rentals has been active in South Texas for 8 years, providing a complete line of equipment for oil and gas drilling operations.

BS&B Names Oil Field District Sales Managers

The appointment of John Raidl and William E. Lacy as oil-field district sales managers at Houston and Los

JOHN RAIDL

W. E. LACY

Angeles, respectively, has been announced by Floyd Myers, manager of oil-field sales and service, Black, Sivalls & Bryson, Inc.

Raidl, who served as district sales manager at Los Angeles for the past 2 years, was formerly assistant sales manager for safety heads in Kansas City for 4 years.

Lacy, who succeeds Raidl as district sales manager at Los Angeles, came to BS&B in 1950 after serving 3 years as project engineer with J. F. Pritchard & Co. in Kansas City. Lacy was transferred to Los Angeles in 1951 as senior sales engineer, later became city sales manager and then district engineer.

Polyken Adds Distributors For Tape Coatings Line

The Polyken Sales Division of The Kendall Co. recently enfranchised two new distributors to carry its protective tape coatings line. Farwest Corrosion Control Corp., Seattle, Wash., with a branch in Los Angeles, will service the West Coast. William Cluff Corp., Tulsa, will serve the Southwest and Rocky Mountain area. Both distributors carry the complete Polyken polyethylene protective tape coatings line.

Rector Appoints Sales Service Representatives

Paul G. Honeycutt and R. F. Clinkscales have been appointed sales service representatives for Rector Well Equipment Co., Inc., according to J. L. Pinkard, sales manager. Honeycutt will make his headquarters in the company's New Orleans office, with warehouse facilities in Harvey, La. Clinkscales will headquarter at Houston.

Before joining Rector, Honeycutt had been with Baker Oil Tools, Inc., for 8 years as branch manager and service engineer. Clinkscales joins Rector after 5½ years as a partner in a well-control firm. Prior to that he had been with Mike Hicks Tool & Cementing Co., Spartan Tool Co., and McCullough Tool Co.

Crane Elects Greene as Vice President of Sales

The election of Joseph W. Greene as vice president of sales for Crane Co. has been announced by Neele E. Stearns, president. Charles W. Lovelace, manager of the company's valve and fitting department, has been named to succeed Greene as director of industrial sales.

Greene will head a realigned department organization which will coordinate industrial sales previously conducted on a divisional basis. Greene will also direct Crane marketing research and advertising-sales promotion activities.

Greene joined Crane Co. as an industrial salesman in 1936. He served in various sales capacities in Houston, Chicago, and New York and in 1954 was named eastern district manager. Greene has been director of industrial sales at company headquarters in Chicago since 1956.

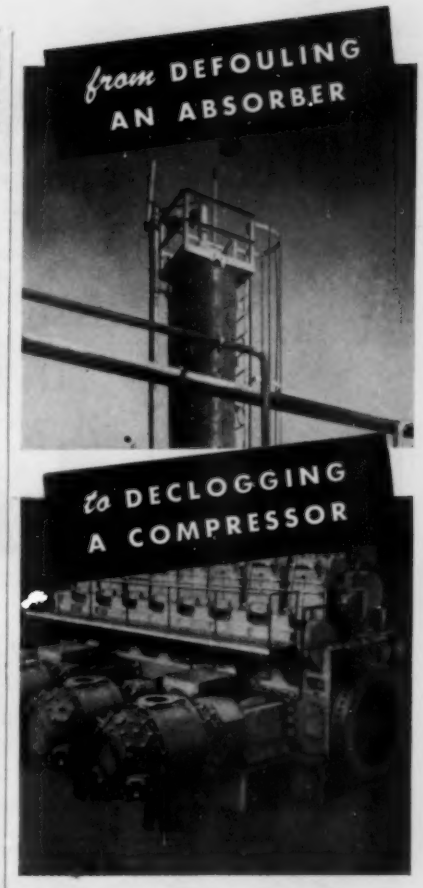
Lovelace joined Crane in 1938. He worked in oil-industry sales at Chicago, Shreveport, and Memphis. In 1947 he was appointed assistant manager at Memphis and in 1954 became manager at Detroit. He was named manager of the valve and fitting department in 1956.

Ideco Changes Name, Appoints Walton President

G. W. WALTON

Announcement has been made that Ideco Division of Dresser Equipment Co. has been reorganized and will be known as Ideco, Inc. Concurrently with this announcement, J. B. O'Connor, president of Dresser Industries, Inc., also announced appointment of G. W. (Jack) Walton as president of Ideco, Inc., manufacturer of drilling rigs and other oil-well drilling equipment.

Since 1954 Walton has been executive vice president of this Dresser subsidiary. Other officers reappointed in the new company in the same capacity as before include W. O. Cook, vice president in charge of engineering and manufacturing; G. G. Wilbur, assistant to the president and vice president in charge of export sales; and E. F.



Oakite in-place cleaning improves results, saves time

Removing asphaltic deposits manually from 45 ft. tower took toll of 4 days production for shutdown. Oakite chemical circulation method cut time to 20 hours, production loss to less than a day, and cost only ⅓ as much.

Clogging deposits disappear without need for dismantling compressors by pumping Oakite de-sludging and descaling solutions through equipment. In addition, the Oakite Man showed one refiner how compressors could subsequently be kept *free* from scale, eliminating 12 hours shut-down *every* 6 to 8 weeks.

These are but 2 of many ways to save time, trouble and expense with tested Oakite methods and materials. Others are concisely discussed in Booklet F-7629. Write Oakite Products, Inc., 44C Rector Street, New York 6, N. Y.

OAKITE

Export Division Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

Shields, vice president in charge of domestic sales.

Walton entered the petroleum industry 38 years ago as an oil-company purchasing agent. He later served as sales and export representative for various manufacturers of oil-field equipment, being one of the first to set up headquarters abroad. With the widening search for oil, Walton has established agents for his company in every active oil area. Concurrent with his interest in management and sales Walton has been a consistent inventor of new products and improvements in drilling equipment and components.

SPAEF Purchases Kenworth Trucks for West Africa

Societe Des Petroles d' Afrique Equatoriale Francaise has purchased 26 Kenworth trucks for use in Gabon, West Africa. The Kenworths will be delivered in July by ship from Houston to Port-Gentil, Gabon. The trucks will be used to haul drill rigs, heavy equipment, supplies and portable housing facilities.

Placed through Inter-Equipment, Inc., and its affiliated companies abroad, the order calls for 21 Kenworth Model 552's and five Model 853-D's. The entire order was custom-engineered for operating in this country of jungle growth, soft sands, and swamps. The terrain is without roads except those built or cut through by SPAEF.

The Kenworth 552's are 6 by 6's and are equipped with oil-field bodies. The fifth wheel is air-operated and retracts into the body. The 853-D's, also 6 by 6's, have Cummins 300-hp. diesel engines with torque converters and Torqmatic transmissions.

Parkersburg Names Smith To Canadian Sales Post

S. S. SMITH

S. S. Smith has been named Canadian regional sales manager of the pumping unit division for Parkersburg Rig & Reel Co., according to W. J. Slaughter, division manager. Smith who will headquarter at Calgary, Alta., succeeds J. L. Norris who has been transferred to Oklahoma City as district sales manager for pumping units.

Prior to this appointment, Smith was district sales manager for the West Texas-New Mexico district. H. H. Weiser, formerly pumping unit salesman at Grand Junction, Colo., succeeds Smith as district manager at Odessa.

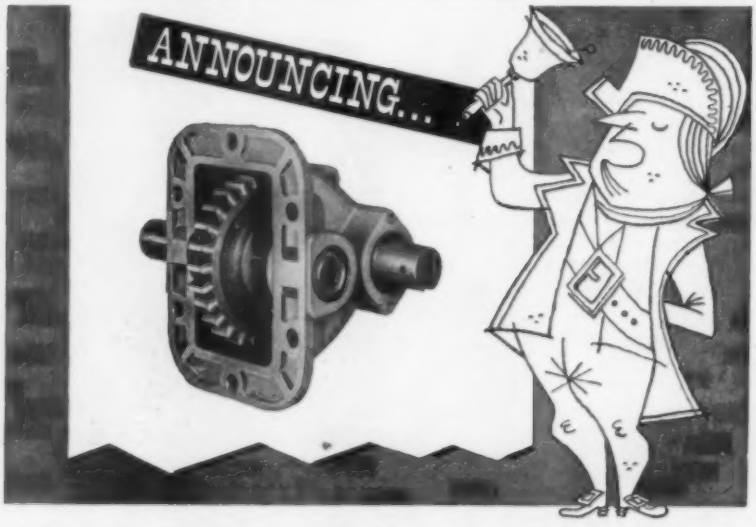
Security Opens South American Headquarters

S. C. WELKER

Opening of South American headquarters in Caracas, Venezuela, has been announced by Security Engineering Division, Dallas. Concurrent with this announcement was the naming of Sam C. Welker as manager of Security's South American activities from newly established headquarters in Caracas.

According to C. L. Lane, Security president, headquarters in South America will provide a more effective service to the Latin American petroleum industry.

Welker was formerly rotary sales supervisor for National Supply Co. in Caracas. He also served as foreign division engineer for Halliburton Oil Well Cementing Co. and Brown Drilling Co. Welker is in the United States to tour Security facilities.



NEW SINGLE SPEED . . . ALUMINUM HOUSING . . . POWER TAKE-OFF

IT'S A TULSA® . . . ALWAYS BEST!

Important features that make this new TULSA power take-off outstanding:

- Die-cast aluminum housing . . . extremely lightweight
- Output shaft rotates on two needle bearings
- Three output shaft sizes
- Cable or lever control
- Low priced

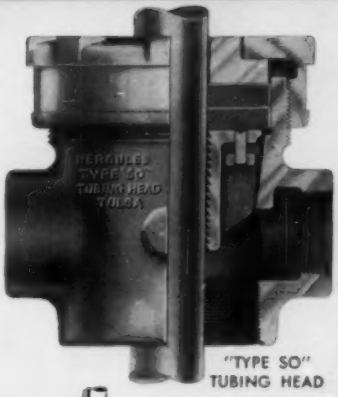
This new power take-off for all medium duty work offers all the advantages of the complete TULSA line—highest quality, nationwide distribution and service.

Tulsa Winch
TULSA, OKLAHOMA DIVISION OF VICKERS Inc.

there's a Hercules tubing head

TO FIT YOUR REQUIREMENTS...

HERCULES "Type SO" Tubing Head is particularly suited for pumping due to compactness (only 12½" high). Stripper rubber can be used in body for running or wiping tubing. Also ideal for intermittently flowing wells.



"TYPE SO" TUBING HEAD

HERCULES "Type SO" and "SOS" Tubing Heads are the favorite of successful operators because of their simplicity, ruggedness and ease of operation. Available in 4½" OD to 7" OD Casing Sizes to suspend 2", 2½" or 3" tubing. Constructed from pressure cast steel and tested to 4,000 PSI. Slips are hinged for ease of installation and positive alignment.

"TYPE SOS" TUBING HEAD

HERCULES "Type SOS" Stripper Tubing Head is unsurpassed for use in well servicing operations as well as on flowing wells. It consists of a HERCULES "Type SO" Tubing Head with a bowl and Neoprene Tubing Stripper.

HERCULES TOOL Company

"MANUFACTURERS OF OIL FIELD EQUIPMENT" SINCE 1924

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Available through all supply stores: Export Representative: Oil Field Equipment Co., Inc., 30 Church Street, New York 7, N. Y.

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CENTRAL SCIENTIFIC COMPANY
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DEW POINT TESTERS

ASTM-D 1142-53

Now Manufactured in Two Models For LP Gas and Natural Gas. 0-1000 psi for LP Gas Vapor and Natural Gas. Model also available in 0-3000 psi. ASTM 11-42-53

PRECISION DETERMINATIONS: Bureau of mines tests show that with manipulation dew points can be duplicated to within 0.2° F.
ACCURACY: Averaging test measurements, the Bureau of Mines reported less than 0.2°F. Dew point temperature difference compared to known standards.
SAFETY: Hydrostatic tests show a maximum working pressure of 3,000 psi. Adjustable mirror allows for safe visual observation into the pressure body.

DEW POINT RECORDER

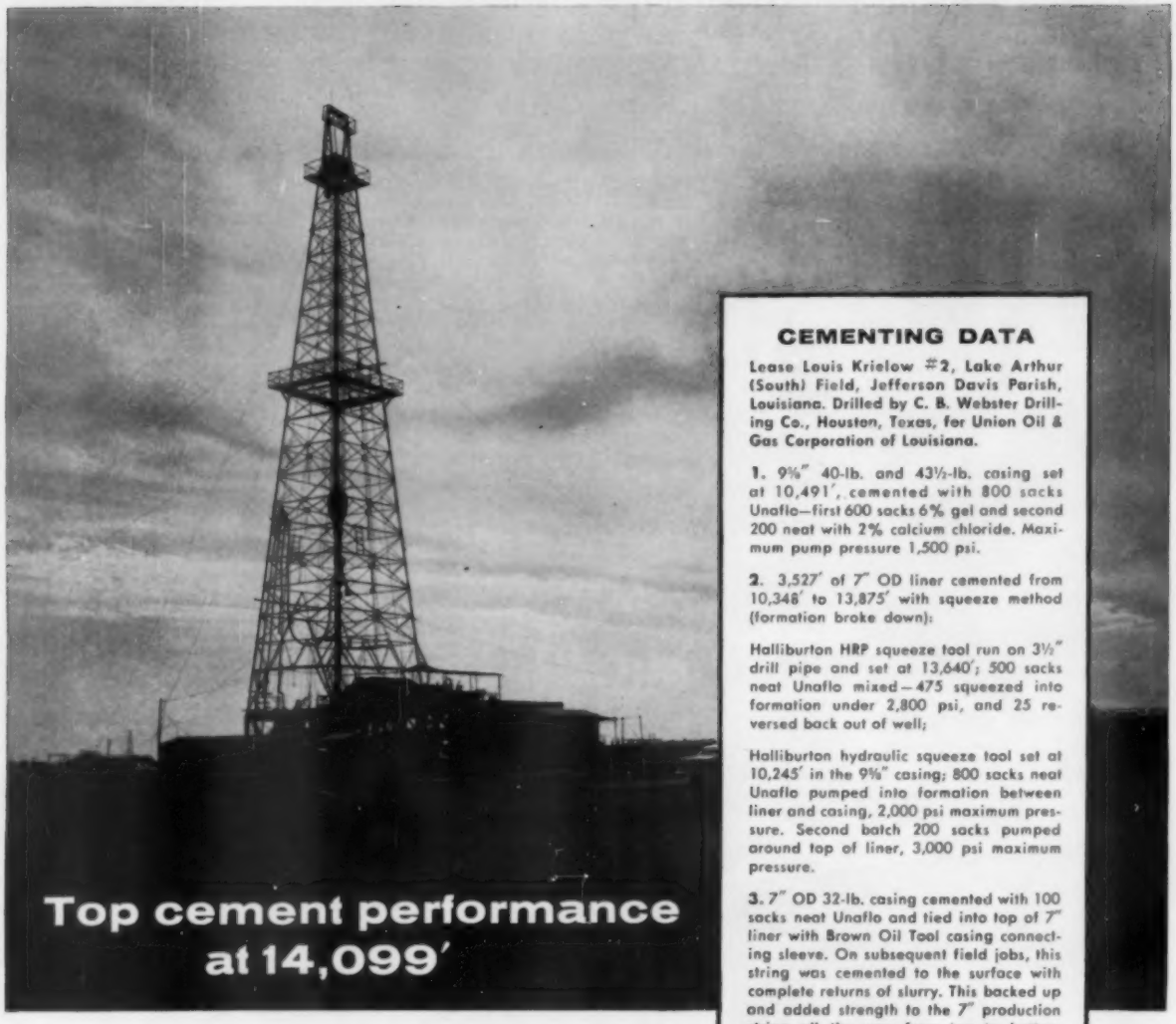
BUREAU OF MINES TYPE

RECORDS DEW POINT OF GASES UNDER PRESSURE

SUITABILITY: For use with gases under pressure; at pressures from atmospheric to 3,000 psi.
CONTINUOUS RECORD: of dew point gas.
RAPID RESPONSE: To changing dew point of gas.
RELIABLE RESULTS: Obtained to allow for the control of dew point of natural gas in long distance high-pressure transmission lines. This instrument records dew point of a continuous sample of natural gas at line pressure up to 3,000 psi.

REFINERY SUPPLY COMPANY

REFINERY SUPPLY COMPANY



CEMENTING DATA

Lease Louis Krielow #2, Lake Arthur (South) Field, Jefferson Davis Parish, Louisiana. Drilled by C. B. Webster Drilling Co., Houston, Texas, for Union Oil & Gas Corporation of Louisiana.

1. 9⅝″ 40-lb. and 43½-lb. casing set at 10,491′, cemented with 800 sacks Unaflo—first 600 sacks 6% gel and second 200 neat with 2% calcium chloride. Maximum pump pressure 1,500 psi.

2. 3,527′ of 7″ OD liner cemented from 10,348′ to 13,875′ with squeeze method (formation broke down):

Halliburton HRP squeeze tool run on 3½″ drill pipe and set at 13,640′; 500 sacks neat Unaflo mixed—475 squeezed into formation under 2,800 psi, and 25 reversed back out of well;

Halliburton hydraulic squeeze tool set at 10,245′ in the 9⅝″ casing; 800 sacks neat Unaflo pumped into formation between liner and casing, 2,000 psi maximum pressure. Second batch 200 sacks pumped around top of liner, 3,000 psi maximum pressure.

3. 7″ OD 32-lb. casing cemented with 100 sacks neat Unaflo and tied into top of 7″ liner with Brown Oil Tool casing connecting sleeve. On subsequent field jobs, this string was cemented to the surface with complete returns of slurry. This backed up and added strength to the 7″ production string all the way from top to bottom of well.

Bottom-hole (Log) temperature at 14,000′ 243° F. Mud weight 17.5 lbs. per gal. (Funnel) viscosity 63 (seconds).

ATLAS UNAFLO* oil-well cement

- On deep jobs like this, oilmen have learned to rely on Unaflo retarded oil-well cement to go into place without a hitch.
- Slurries pump easily, stay fluid and pumpable under severe conditions of temperature and pressure.
- UNAFLO's *retarded set* gives vital extra time in emergencies, yet slurries form a strong, watertight, sulphate-resistant seal.

For typical data tables write:
Universal Atlas, 100 Park Avenue, New York 17, N. Y.

*"UNAFLO" is the registered trademark of the retarded oil-well cement manufactured by Universal Atlas Cement Company.

U-149

UNIVERSAL ATLAS CEMENTS

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UNIVERSAL ATLAS CEMENT COMPANY—member of the industrial family that serves the nation—**UNITED STATES STEEL**

OFFICES: *Albany • Birmingham • Boston • Chicago • Dayton • Kansas City • Milwaukee • Minneapolis • New York • Philadelphia • Pittsburgh • St. Louis • Waco*

Man makes a mountain . . . object: To learn . . .

How Structures Originate

By Frank J. Gardner

GEOLOGISTS believe that some big oil and gas fields lie hidden beneath the complex folds, thrust plates, and steep fault blocks of the Rocky Mountains and their foothill flanks. The belief has been amply strengthened in recent years by the discovery of such fields as Alberta's Pincher Creek, Savanna Creek, Jumping Pound, and, most recently, Waterton Park and Castle River. These are all gas fields, but Turner Valley, in the same vicinity, was an oil field as well; it was Alberta's first field, and has provided much of the key information that led to the other discoveries.

In the United States, the mountain search has not been as rewarding, but certainly the Disturbed Belt of western Montana, and the ranges and foothills of the states to the south, must harbor similar traps. The Appalachians are another possible target.

Rebuilding the earth . . . As an aid to the search for mountain and foothill traps, Gulf Oil Corp. has come up with a unique mountain-building machine. In its research center at Pittsburgh, Gulf is rebuilding the earth on a miniature scale to find how and where oil traps are formed in mountainous areas. Gulf scientists, under the leadership of Dr. J. B. Currie, are aiming at more accurate recognition of these traps from field observations. Eventually they believe they can pin down likely drilling sites in selected areas.

The mountain-building machine is constructed to scale to represent 100 sq. miles to a depth of 1 to 2 miles. It is mounted on a 5-ft.-square table, with metal sides 4 in. high, hinged at the corners. These sides are of double thickness, one sleeved within the other, and can be pulled out in one or more directions. The corner hinges allow deformation of the box into various shapes and sizes by means of motor-driven screw shafts at the corners.

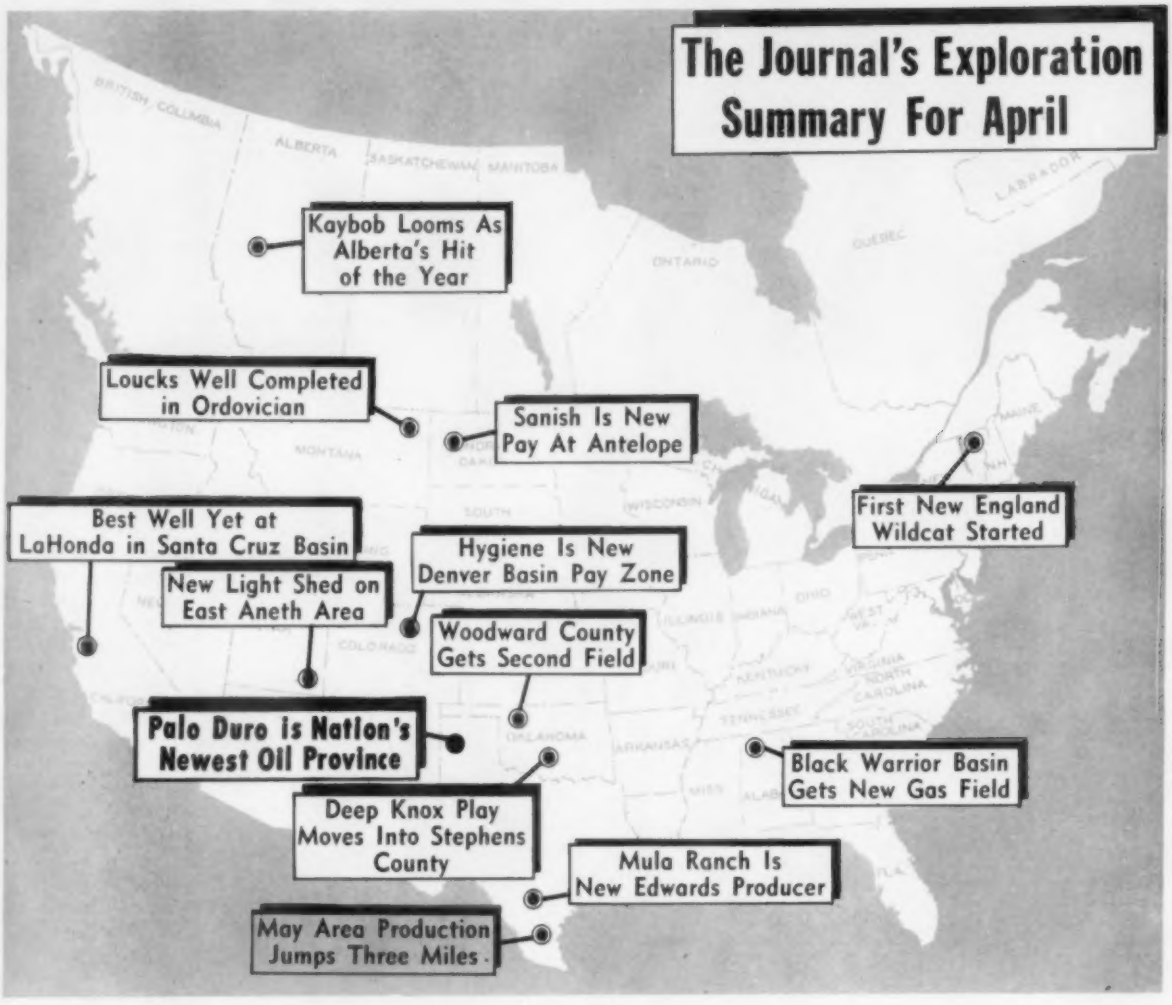
With sheets of clay . . . First into the box goes a heavy rubber sheet to simulate basement rock. On top of the rubber, rolled sheets of clay are deposited; these are carefully compounded to represent different values of strength, density, and other qualities.

The motor-driven screw shafts are then placed in action, applying pressures similar to mountain-building forces in one or more directions against the sides of the model. The other sides may be made immobile or yielding, as the operator prefers. These forces mold the "earth" crust (and the underlying rubber "basement") into folds equivalent to hills and mountains; at various stages of development, the model may be cut into cross-sections for a study of the degree of deformation of the underlying "strata." In the photograph shown here, Dr. Currie is demonstrating such a study by cross-section.

Currie and his staff devote one-third of the time assigned to this project to theoretical calculation, one-third to field observation of actual formations, and one-third to the machine itself. "We do not know what pressures caused the folding of the earth's surface into mountains," he says, "but we are producing forces which give similar results in the model . . . this will enable us to learn more of the mechanical principles governing the development of hilly and mountainous structures." He contends that the immediate practical advantage is the improved ability to recognize the stages that foothills areas go through.

Currie has conducted similar model experiments with the mechanics of salt domes *(The Oil and Gas Journal, April 11, 1955, page 167)*. His machine for these experiments graphically disclosed the birth and growth of faults and fault patterns, and it provided some answers to subsurface puzzles of faulting that had long plagued geologists.

May lead to discoveries . . . With this new model, Gulf hopes to uncover the answers to puzzles just as complex. And if it helps in the discovery of foothill and mountain traps, it will have served its purpose well. Currie believes it will.


The Journal's Exploration Summary For April
Kaybob Looms As Alberta's Hit of the Year
Loucks Well Completed in Ordovician
Sanish Is New Pay At Antelope
First New England Wildcat Started
Best Well Yet at LaHonda in Santa Cruz Basin
Hygiene Is New Denver Basin Pay Zone
New Light Shed on East Aneth Area
Woodward County Gets Second Field
Palo Duro is Nation's Newest Oil Province
Black Warrior Basin Gets New Gas Field
Deep Knox Play Moves Into Stephens County
Mula Ranch Is New Edwards Producer
May Area Production Jumps Three Miles

Texas Panhandle leads April activity as . . .

A New Basin Appears—Palo Duro

By John C. McCaslin
District Editor

APRIL exploration came up with some of the most significant discoveries of the year in both the United States and Canada, but the opening of the Palo Duro basin in the Texas Panhandle offsets all other events.

A New Province

Shell Oil Co. officially opened the first new oil-producing province in this country since the Rehm field discovery cracked opened the Dalhart basin 2 years ago. The 1 Alamosa Ranch, 13 miles northwest of Vega in Oldham County, Texas Panhandle, flowed oil at the rate of 480 bbl. per day from perforations in the Pennsylvanian at 6,101-23 ft. Gravity is 40°. The Shell discovery opens the last of the three Texas Panhandle basins.

Nearest production to the Alamosa Ranch well is about 40 miles north in Hartley County's Rehm field in the Dalhart basin. Successful completion of the Shell well would bring wildcat drills into a vast high plains area of 32,000 sq. miles. The basin has a drilling density of less than one wildcat per 100 sq. miles. More than 11,000 ft. of Permian and Pennsylvanian sediments stud the subsurface. These rocks were laid down at the same time the Permian and Delaware basins were receiving sediments.

The Palo Duro basin is bordered on the north by the Amarillo uplift, on the northwest by the Bravo dome, and on the south by the Matador arch. It lies between two of Texas' most productive basins, the Anadarko and Permian. We should see some important exploration in this evasive country in the coming months.

Prolific Kaybob

Western Canada's flush discovery this year is Phillips Petroleum Co. 1 Kaybob, 145 miles northwest of Ed-

Total April Completions, Exploration and Development

	Total completions							Total wildcat wells							Act.
	Total	Oil	Gas	Dry	Footage	Ser.	C.	Total	Oil	Gas	Dry	Footage	C.T.	D.D.	op.
Alabama	11	8	1	2	105,923	0	0	3	0	1	2	14,212	2	0	25
Arkansas	61	42	2	17	182,064	0	0	12	1	1	10	44,839	0	0	87
California	156	119	3	34	684,898	0	0	33	7	0	26	169,750	0	1	223
Colorado	46	12	4	30	246,001	0	0	29	4	1	24	154,167	0	0	58
Florida	1	0	0	1	6,896	0	0	1	0	0	1	6,896	0	0	3
Georgia	1	0	0	1	4,995	0	0	1	0	0	1	4,995	0	0	2
Illinois	186	72	0	114	432,225	0	0	47	2	0	45	83,954	40	6	391
Indiana	49	15	0	34	79,663	0	0	14	1	0	13	19,735	34	0	87
Kansas	274	112	24	138	1,015,473	4	0	72	9	1	62	298,543	14	1	398
Kentucky	95	36	14	45	154,357	0	0	19	2	2	15	35,163	102	0	231
West	72	34	2	36	93,255	0	0	15	1	2	12	22,951	79	0	153
East	23	2	12	9	61,102	0	0	4	1	0	3	12,312	23	0	78
Louisiana	267	141	24	102	2,329,077	0	1	52	6	5	41	596,055	0	0	455
North	68	44	3	21	261,437	0	1	5	0	0	5	28,148	0	0	129
South	134	55	15	64	1,459,901	0	0	39	6	3	30	472,606	0	0	226
Offshore	65	42	6	17	607,739	0	0	8	0	2	6	95,301	0	0	100
Michigan	27	13	0	14	66,834	0	0	11	0	0	11	25,499	22	0	85
Mississippi	35	13	0	22	238,865	0	2	15	2	0	13	107,033	1	0	40
Montana	24	13	0	11	146,385	0	0	6	0	0	6	29,275	6	0	62
Nebraska	53	13	0	40	309,100	0	0	25	4	0	21	129,793	2	0	48
West	51	13	0	38	307,435	0	0	23	4	0	19	128,128	0	0	45
East	2	0	0	2	1,665	0	0	2	0	0	2	1,665	2	0	3
New Mexico	154	93	32	29	704,177	0	0	22	6	0	16	99,920	6	1	203
Northwest	48	10	31	7	192,772	0	0	9	2	0	7	37,316	0	0	78
Southeast	106	83	1	22	511,405	0	0	13	4	0	9	62,604	6	1	125
New York	37	18	0	19	37,000	19	0	0	0	0	0	0	37	0	21
North Dakota	15	11	0	4	109,705	0	0	3	1	0	2	15,490	0	0	31
Ohio	65	29	16	20	175,360	9	0	0	0	0	0	0	59	0	127
Oklahoma	502	306	9	187	1,709,631	40	6	57	8	3	46	256,804	73	20	769
Pennsylvania	21	0	16	5	144,917	0	0	5	0	3	2	33,098	17	0	73
South Dakota	6	0	0	6	24,159	0	0	6	0	0	6	24,159	0	0	5
Texas	1,653	1,032	72	549	6,812,570	15	32	358	53	14	291	1,679,572	88	7	1,310
Dist. 1	143	83	4	56	342,373	0	1	39	2	2	35	108,227	2	0	43
Dist. 2	51	19	12	20	326,334	0	6	18	3	3	12	116,089	0	0	51
Dist. 3	127	67	7	53	852,801	0	12	47	5	5	37	384,049	0	1	124
Dist. 4	113	46	14	53	623,752	0	7	43	10	0	33	250,847	0	0	72
East	100	40	7	53	515,444	0	2	37	0	0	37	191,856	0	0	54
Dist. 7-B	180	95	5	80	546,521	0	0	50	9	2	39	152,902	28	1	87
West	473	395	9	69	2,290,031	4	0	45	7	2	36	231,060	40	4	626
Dist. 9	359	199	3	157	893,612	11	0	74	15	0	59	212,508	18	1	141
Panhandle	107	88	11	8	421,702	0	4	5	2	0	3	32,034	0	0	112
Utah	17	9	1	7	102,717	0	0	10	2	1	7	60,801	0	0	45
West Virginia	47	7	33	7	113,659	0	0	0	0	0	0	0	45	0	190
Wyoming	54	30	1	23	217,734	0	0	17	1	0	16	99,197	14	0	108
Total April 1957	3,857	2,144	252	1,461	16,154,585	87	41	818	*109	32	677	3,988,950	562	36	5,077
Total Mar. 1957	4,138	2,164	346	1,628	16,685,594	187	38	843	97	34	712	4,192,840	810	55	5,312
Cum. 1957	17,160	9,208	1,260	6,692	71,244,119	386	136	3,914	487	159	3,268	19,086,985	2,580	174	....
Cum. 1956	18,656	10,324	1,222	7,110	76,652,000	....	....	4,089	572	118	3,399	19,745,000	....	....	....
Western Canada	101	70	6	25	566,857	....	....	25	4	3	18	171,947	....	....	....
Alberta	51	30	4	17	349,746	....	....	18	3	2	13	138,048	....	....	....
Saskatchewan	43	38	0	5	186,433	....	....	3	0	0	3	13,198	....	....	....
Manitoba	1	1	0	0	2,100	....	....	....	....	....	....	....	....	....	....
British Columbia	6	1	2	3	28,578	....	....	4	1	1	2	20,701	....	....	....
Canada cum. 1957	870	579	46	245	4,095,977	....	....	238	23	20	195	1,145,457	....	....	....
Alberta cum.	445	277	32	136	2,390,316	....	....	139	11	16	112	747,703	....	....	....
Sask. cum.	313	242	1	70	1,368,628	....	....	62	9	0	53	247,588	....	....	....
Manitoba cum.	80	57	0	23	178,069	....	....	17	0	0	17	47,596	....	....	....
B. C. cum.	30	3	13	14	151,860	....	....	18	3	4	11	95,466	....	....	....
N.W.T. cum.	2	0	0	2	7,104	....	....	2	0	0	2	7,104	....	....	....

*Incl. 10 cond. disc.: Okla. 1, Texas (3) 4, Texas (4) 4, Texas Panhandle 1.

Note: Ser. (service wells); C. (cond. wells); C.T. (cable-tool compl.); D.D. (O.W.D.D.); Act. op. (active operations).

monton in Alberta. The wildcat flowed oil at a daily rate of 2,350 bbl. on small choke from 45 ft. of porous reef in the Cooking Lake-Devonian formation at 9,572-9,625 ft. on 2-hour drill-stem test.

Kaybob is 35 miles west of Virginia Hills-Devonian (Slave Point) field, adding a significant link to the apparent Devonian trend shaping up from Swan Hills on the northeast through Virginia Hills, then west to Kaybob. The Virginia Hills and Swan Hills discoveries have commanded Canadian wildcat interest throughout the first 4 months of this year. Everyone up there is speculating as to the extent of this Devonian prospect, but many more wildcats will have to go down before anything definite can be decided. Offset wells are busy in and around Virginia Hills and Swan Hills, and due to the lack of muskeg that pestered Red Earth Creek operators last year, full evaluation of these two areas can be expected soon.

The Regional Picture

In Alabama . . . The Black Warrior basin of northwestern Alabama gained a new gas field in April. Walter Pearson and Associates 2 First National Bank of Birmingham flowed 3,600 M.c.f. of gas per day from Lewis (Bethel) sand of Mississippian age. The Marion County discovery is the state's first since Citronelle in 1955, and is the first real activity in this particular basin since the flurry of gas strikes several years ago put the Black Warrior on the map.

In Vermont . . . New England's first wildcat began operations near St. Albans, Vermont, just south of recent

Footage Breakdown for April 1, 1957

	Fields			Wildcats		
	Oil	Gas	Dry	Oil	Gas	Dry
Alabama	91,711				1,641	12,571
Arkansas	106,755	2,948	27,522	3,634	2,905	38,300
California	459,246	18,150	37,752	56,717		113,033
Colorado	41,638	17,492	32,704	28,268	5,224	120,675
Florida						6,896
Georgia						4,995
Illinois	172,159		176,112	5,581		78,373
Indiana	24,792		35,136	2,615		17,120
Kansas	349,449	102,849	264,632	32,998	4,730	260,815
Kentucky	33,593	32,693	52,908	6,682	1,923	26,558
West	32,208		38,196	3,150	1,923	17,778
East	1,385	32,693	14,172	3,532		8,780
Louisiana	1,014,047	195,042	523,933	74,650	60,802	460,603
North	142,937	13,366	76,986			28,148
South	515,932	138,334	333,029	74,650	39,358	358,598
Offshore	355,178	43,342	113,918		21,444	73,857
Michigan	35,605		5,730			25,499
Mississippi	75,353		56,479	17,464		89,569
Montana	95,022		22,088			29,275
Nebraska	58,196		121,111	25,488		104,305
West	58,196		121,111	25,488		102,640
East						1,665
New Mexico	417,665	134,928	51,664	37,696		62,224
Northwest	29,325	126,131		12,135		25,181
Southeast	388,340	8,797	51,664	25,561		37,043
New York	18,000		19,000			
North Dakota	82,880		11,335	6,795		8,695
Ohio	80,965	48,333	46,062			
Oklahoma	996,496	27,317	429,014	40,063	19,443	197,298
Pennsylvania		93,100	18,719		22,988	10,110
South Dakota						24,159
Texas	3,905,928	307,277	919,793	280,757	100,246	1,298,569
Dist. 1	163,536	20,583	50,027	4,327	15,680	88,220
Dist. 2	114,823	46,773	48,649	22,801	22,106	71,182
Dist. 3	336,335	16,788	115,629	39,210	45,188	299,651
Dist. 4	184,638	79,662	108,605	67,861		182,986
East	212,985	41,126	69,477			191,856
Dist. 7-B	282,517	9,972	101,130	30,267	6,522	116,113
West	1,848,750	42,006	168,215	43,180	10,750	177,130
Dist. 9	435,010	17,929	228,165	57,495		155,013
Dist. 10	327,334	32,438	29,896	15,616		16,418
Utah	41,916			11,385	2,870	46,546
West Virginia	9,524	83,764	20,371			
Wyoming	105,263	2,870	10,604	6,850		92,347
Total U. S.	8,216,203	1,066,763	2,882,669	637,643	222,772	3,128,535
Western Canada	337,381	20,912	36,617	25,614	25,836	120,497
Alberta	171,051	16,883	23,764	21,814	19,217	97,017
Saskatchewan	164,230		9,005			13,198
Manitoba	2,100					
British Columbia		4,029	3,848	3,800	6,619	10,282

gas discoveries in the Quebec Lowlands. The interesting wildcat is the Maquam Oil & Gas Development Corp. 1 Isadore Yandow near Lake Champlain. The operators may take this one to 5,000 ft.

In South Texas . . . Arkansas Fuel Oil Corp. jumped May area production in southeastern Kleberg County, South Texas, 3 miles southeast. The May area (opened in 1955) is spreading rapidly with multiple-pay extensions in pay zones from 6,900 to 9,350 ft. There are eight oil and gas wells here.

. . . Edwards trend. The growing Edwards producing area in Southwest Texas bagged its first discovery this year at old Mula Ranch field in McMullen County. Jupiter Oils, Inc., 2 South Texas Syndicate flowed 8,000 M.c.f. of gas per day, open flow, from perforations at 10,530-51 ft. and 10,554-75 ft. Mula Ranch is an old Wilcox field abandoned since 1954.

In Oklahoma . . . Woodward County gained its second producing area. A Champlin Oil & Refining Co. wildcat just south of the city of Woodward in northwestern Oklahoma, the 1 McDonald, flowed 9.1 M.M.c.f. of gas per day and 35 bbl. of distillate per 1,000 M.c.f. from perforations in the lower Morrow-Penn sand at 8,256-61 and 8,277-89 ft. This discovery is a big boost to the growing chain of Morrow fields on the north shelf of the Anadarko basin. Champlin staked another wildcat to the northwest of 1 McDonald at month's end.

. . . Knox deep. Bromide-Ordovician production in Knox field, Oklahoma's deepest producing area, moved into Stephens County, 3 miles southeast of other deep wells in this Grady County field.

British-American Oil Producing Co. et al 1 Kreiger flowed 6,800 M.c.f. of gas per day from ultradeep perforations in the second Bromide sand at 14,807-92 ft.

In Paradox . . . The April newsmaker in the Paradox basin of southeastern Utah was Continental Oil Co.'s 1 Navajo-H, 3 miles east of Aneth field proper and 5 miles west of East Aneth. This wildcat flowed 171 bbl. of oil in 16½ hours on tests of the Pennsylvanian-Paradox at 5,930-52 ft. It is separated from the two mentioned fields by dry holes.

In Santa Cruz . . . The best oil well yet in the shallow reservoir that is being developed in California's Santa Cruz basin is Neaves Petroleum Co. 5 Neaves-Union-Lane in LaHonda field. The well flowed 321 bbl. per day from a Butano sand zone at 1,740 ft. Location is 8 miles northwest of Oil Creek field, the first producer in the Santa Cruz Mountains in northern California.

In Williston . . . The second successful well in northeastern Montana's new Outlook area was completed in the Red River-Ordovician. Amerada Petroleum Corp. 1 Loucks, 4 miles southwest of the 1 Tange which opened Outlook field (Silurian), flowed 312 bbl. of oil per day and 34 bbl. of water from perforations at 9,896-9,916 ft.

Two other wells are drilling in this general Sheridan County area of Montana. This section of the basin is the most closely watched wildcat area this year. The discovery of oil in deeper-than-Madison formations in the basin has fired a new badly needed wildcat enthusiasm in western North Dakota and northeastern Montana.

. . . Sanish. The Sanish sand of lower Mississippian Bakken age is a new pay for North Dakota's Antelope field. Pan American Petroleum Corp. 1 Lewis flowed 640 bbl. of oil daily on tests of this deeper Mississippian pay at 10,273-97 ft. The Sanish previously produced in only one area—Sanish field.

In Denver basin . . . The Denver basin of northeastern Colorado added a new pay sand—the Hygiene of Upper Cretaceous Pierre shale age. The discovery well is California Co. 1 Denny in Weld County. It pumped 90 bbl. of oil per day from 4,274-83 ft. Other basin production is from the Dakota Group Upper Cretaceous and from the Permian-Lyons sand.

(Other tables on pp. 315-316)

Breakdown of Wildcats Drilled in April 1957, by Depth

	Oil									Gas									Dry								
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Alabama											1												2				
Arkansas			1									1								3	4	1	1	1			
California		1	1	1		1	1	2											5	5		4	4	5	3		
Colorado				1	1	2								1							1	7	16				
Florida																							1				
Georgia																						1					
Illinois			2																16	21	6	2					
Indiana			1																5	8							
Kansas		2	3	3	1								1								20	35	7				
Kentucky			2							1	1								7	5	3						
West			1							1	1								6	4	2						
East			1																1	1	1						
Louisiana						1	1	4								3	1	1			1	1	2	6	18	9	4
North																					1	1	2	1			
South						1	1	4								1	1	1						4	15	7	4
Offshore																2								1	3	2	
Michigan																			1	6	3	1					
Mississippi					1		1															1	8	4			
Montana																					3	1	1	1			
Nebraska					4														2	1	2	3	13				
West					4															1	2	3	13				
East																			2								
New Mexico			2		2	1	1													4	3	6	3				
Northwest					2															3	2		2				
Southeast			2			1	1													1	1	6	1				
North Dakota					1																1		1				
Oklahoma	1		1	3	1	2								3					4	8	12	9	6	5	2		
Pennsylvania														1	2						1		1				
South Dakota																			1	1	2		1	1			
Texas	1	9	7	7	18	9	2					2	2	3	5	2			21	62	53	42	67	39	5	2	
Dist. 1		1	1											1		1			9	10	10	4	2				
Dist. 2					2	1							1	1		1				1		3	4	4			
Dist. 3					1	4									5						1		13	18	5		
Dist. 4				1	6	3														1	5	4	17	6			
East																				4	4	10	14	5			
Dist. 7-B	1	2	1	5								2							4	12	13	6	4				
West		1	1	1	2		2						1	1					2	5	7	8	7	5		2	
Dist. 9		5	4		6														6	28	13	7	5				
Dist. 10					1	1														1			1	1			
Utah					2							1							1				4	1	1		
Wyoming					1														1	1	2	3	6	2		1	
Total U. S.	2	12	20	15	32	16	6	6		1	2	4	3	8	7	5	1	1	64	125	117	117	144	65	29	12	4
Western Canada				1	2	1								2			1				1	4	9	2	2		
Alberta					2	1								1			1					2	7	2	2		
Saskatchewan																					1	1	1				
Manitoba																											
British Columbia				1										1								1	1				

NOTE: A = 0-1,250 ft.; B = 1,250-2,500 ft.; C = 2,500-3,750 ft.; D = 3,750-5,000 ft.; E = 5,000-7,500 ft.; F = 7,500-10,000 ft.; G = 10,000-12,500 ft.; H = 12,500-15,000 ft.; I = 15,000 ft.

Breakdown of Field Wells Drilled in April 1957, by Depth

	Oil									Gas									Dry								
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Alabama							8																				
Arkansas	2	24	11	3	1							1								1	4	1		1			
California	15	30	22	13	10	15	5	2					1	2					1	1	1	1	2	1	1		
Colorado		2	1		3	2								3									6				
Illinois	7	24	38	1															6	20	42	1					
Indiana	4	8	2																9	9	3						
Kansas		13	62	26	2							3	13	7						8	47	17	4				
Kentucky	25	9								1	2	6	3						11	14	4	1					
West	25	8																	9	12	3						
East		1								1	2	6	3						2	2	1	1					
Louisiana	1	25	9	8	18	30	32	10	2		2			2	6	2	6	1		3	8	1	16	8	13	8	4
North	1	25	9	3	4	1	1				2				1					2	5		9				
South				4	4	8	22	9	2					2	3		6	1		1	3	1	6	5	9	5	4
Offshore				1	10	21	9	1							2	2							1	3	4	3	
Michigan		7	3	1	2															3							
Mississippi				2	7	1	1															3	5		1		
Montana		1	1		5	6															2		3				
Nebraska, W.					9																		19				
New Mexico	1	13	18	36	6	2	9	2			8	9	1	11	3				2	5	1	2	1			2	
Northwest		4			4						8	9	1	11	2												
Southeast	1	9	18	36	2	2	9	2							1				2	5	1	2	1			2	
New York	18																		19								
North Dakota			1			9															1			1			
Ohio	5		23	1						1	2	10	3						2	10	7	1					
Oklahoma	16	98	96	45	26	12	5				1	2	1	2					15	45	48	14	13	6			
Pennsylvania														13									3				
Texas	82	224	270	155	153	70	20	5			8	12	6	21	6	5			30	100	32	28	41	22	3	2	
Dist. 1	29	29	14	7	1	1										2			6	9	3	2	1				
Dist. 2			1	3	6	6							2	6	1						1	2	3	2			
Dist. 3	7	4	8	12	9	17	5						1			1					1	2	4	8	1		
Dist. 4	3	2	6	5	16	3	1					5	1	4	4					5	3		7	4		1	
East		7		7	25	1							2	5					2	2		5	6	1			
Dist. 7-B	5	33	15	23	10						2			1					5	21	9	4	2				
West	11	44	138	70	75	32	13	5				3		2		2			2	2	8	6	9	3	2	1	
Dist. 9	27	100	20	28	8	1								3					15	60	6	7	9	1			
Dist. 10		5	68		3	9	1				6	4			1					1	1			3			
Utah					7																						
West Virginia	3	4								2	17	9	5							1	4	2					
Wyoming	3	5	12	3	3	3						1							4	1	2						
Total U. S.	182	487	569	294	252	150	80	19	2	4	40	53	33	61	15	7	6	1	99	221	206	72	113	39	18	12	4
Western Canada		5	4	40	4	13							2			1						4	2	1			
Alberta		4		6	4	13							1			1						1	2	1			
Saskatchewan			4	34																		2					
Manitoba		1																									
British Columbia													1									1					

NOTE: A = 0-1,250 ft.; B = 1,250-2,500 ft.; C = 2,500-3,750 ft.; D = 3,750-5,000 ft.; E = 5,000-7,500 ft.; F = 7,500-10,000 ft.; G = 10,000-12,500 ft.; H = 12,500-15,000 ft.; I = 15,000 ft.

EXPLORATION HIGHLIGHTS

APPALACHIAN

PENNSYLVANIA

In Mount Pleasant Township, Westmoreland County, Southwest Pennsylvania, Peoples Natural Gas Co. 4105 Benedictine Society, wildcat, had a final open flow of 6,852,000 cu. ft. of gas after fracture. The Tully was at 6,656 ft., Onondaga 7,272 ft., chert 7,288 ft. with gas, Oriskany sand 7,427 ft. Total depth 7,465 ft.

WEST VIRGINIA

● Meadow Bluff district, Greenbrier County, West Virginia, Hope Natural Gas Co. is making road to 10083 Gauley Coal Land Co., rank wildcat. It is on Tract No. 499 at an elevation of 2,901 ft., Winona Quadrangle 1.05 miles south of latitude 38 degrees .05 minutes and 0.30 mile west of longitude 80 degrees 50 minutes.

● In Wilderness district, Nicholas County, this company is also making road to 10084 Gauley Coal Land Co., Tract No. 481-1. It is on the same quadrangle 4.80 miles south of latitude 38 degrees 10 minutes and 2.98 miles west of longitude 80 degrees 45 minutes.

OHIO

The third and fourth producers confirm an important pool southeast of Wooster in Franklin Township, Wayne County. Smith Petroleum 2 Lizzie Miller, Section 15, logged Clinton sand at 3,400-26 ft. with 800,000 cu. ft. gas (cemented off) and sand at 3,428-77 ft. with 25 bbl. natural. After fracture the first day's production was 150 bbl. oil and 1,100,000 cu. ft. gas. Smith Petroleum 1 L. Harrison, Section 15, logged sand at 3,591-3,637 ft. with 200 bbl. natural and 125 bbl. after fracture.

● Gas production in northern Knox Township, Holmes County, was extended ⅓ mile east with the completion of Ohio Fuel 1 Jeanette Brown, Section 29. Clinton was topped at 2,770 ft. with a gage of 5,100,000 cu. ft. natural at 2,789 ft.

EASTERN KENTUCKY

Northeast of the town of Sizerock and located on Left Fork of Elkhorn Creek, Leslie County, United Fuel Gas Co. is drilling at 4,791 ft. in a probable Ordovician strata at their wildcat 28 Fordson Coal Co. This test, projected to penetrate Cambrian formations topped Mississippian Big Lime at 1,630 ft. and Devonian black shale at 2,202 ft. A show of oil was logged at 4,466 ft.

CALIFORNIA

Richfield Makes Marginal Discovery at Wheeler Ridge

Richfield Oil Corp. has added another new pool discovery to the multiple pool Wheeler Ridge field in southern Kern County. The latest find, in NE NE 25-11n-20w, tapped what appears to be a sub-commercial zone in the Zemorian at 8,445-8,505 ft. Initial production of the discovery, 61-25 ROC-KCL, was flowing only 17 bbl. daily of 48.3°-gravity crude, 20 per cent cut. This wildcat is located about ¾ mile northwest of Richfield's Wheeler Ridge community deeper pool discovery of last February and about 2½ miles east of regular Wheeler Ridge field production.

Standard Abandons First Summerland Core Hole

Standard Oil Co. of California, as operator for itself and Humble Oil & Refining Co., has plugged and abandoned its first core hole on a 5,500-acre offshore lease at Summerland. This initial hole, drilled from a platform in 75 ft. of water about 1½ miles from shore, was taken to 8,454 ft. The platform has been towed to a new location on the lease for another core hole. The core-hole program is designated to evaluate the lease prior to building either a permanent platform or island for development drilling.

New Poso Creek Pool

M. J. M. & M. Oil Co. gave Poso Creek field in Kern County a new fault block discovery in the Premier area with 3 USL-Snow. The discovery was completed on the pump for 200 bbl. daily gross, 50 bbl. net, of 12°-gravity crude from an interval at 2,245-2,348 ft. The zone is in the Etchegoin sand. The operator reports this well has the pay zone 110 ft. higher than in 1 USL-Snow just one location to the west.

Shell Scores at Rosedale

Shell Oil Co. completed 53-14 KCL as a new pool discovery in the Rosedale area of Kern County. The discovery is about ¾ of a mile northeast of the nearest Rosedale field producer and is on the north edge of the small town of Rosedale in 14-29s-26e. It flowed by heads at a rate of 76 bbl. daily of 30.5°-gravity crude, 20/64-in. choke, 1.2 per cent cut. Production is from three perforated intervals at 6,892-6,910 ft., 6,960-75 ft., and 6,985-7,000 ft. Total depth is 10,029 ft. plugged back to 7,080 ft.

Continental Quits Deep Paloma Test

Continental Oil Co. has abandoned 55-8 KCL, a 13,586-ft. wildcat ¾ of a mile southeast of Paloma field production in Kern County. This test was located about 4 miles southeast of Ohio Oil Co.'s former world depth record holder which was abandoned several years ago at 21,482 ft.

CANADA

ALBERTA

Tests Completed At Waterton Park

An exremely interesting and significant well drilled in the southwestern sector of Alberta Shell Oil Co. has completed testing operations and was rated with an initial potential of 6,000,000 cu. ft. daily along with a condensate recovery of 30 bbl. per million cubic feet. This discovery well, Shell 1 Waterton Park, on LSD 4, 21-4-1w5, is 21 miles north of the U.S. border, 9½ miles west of gas production in the fabulous Pincher Creek field and just over 10 miles south-southwest of a recent gas strike in the Castle River area made by Texaco Exploration Co.

In making the release, R. B. Wing, exploration manager of Shell, stated that based on a 10-day test, the well flowed 6,000,000 cu. ft. of gas per day through a 24/64-in. choke, with 30 bbl. of condensate being recovered per million cubic feet. The success was drilled to a total depth of 14,045 ft and took nearly one full year to complete—it was spudded on May 21, 1956 and completed in April of this year.

Exploration This Week

Appalachian	317
California	317
Canada	317
Louisiana	318
Michigan	320
Mississippi	320
Nevada	320
Oklahoma	320
Rocky Mountain	320
Texas	321
Successful Wildcats	323

Although it was carried to total depth below 14,000 ft. it is not the deepest well in western Canada. The deepest well is, however, a Shell venture, 4 Jumping Pound that was completed at total depth of 14,443 ft. (Canada's deepest well was drilled in Prince Edward Island by Island Development Co. and was carried to a total depth of 14,696 ft. before being abandoned as a dry hole.)

The 1 Watertown Park is producing from the Banff section of the Mississippian. String of 7-in. casing is set at 11,332 ft. and the gas pay zone is open in the interval from the bottom of casing to 12,100 ft. The formation was treated with acid prior to running the extended production tests.

Shell Oil holds exploration rights on a little over 201,000 acres in the general area. It's most recent acquisition, for which a cash bonus of $751,000 was paid, consists of a drilling reservation of 11,047 acres lying southeast of the firm's original acreage block. In order to earn leases on 2,560 acres out of that tract the company is committed to drill a well to test the Turner Valley sector of the Mississippian. Another company with acreage holdings in the area, Texaco Exploration, Ltd., recently announced a new drill start in the immediate vicinity and will start drilling operations as soon as a rig is moved onto the site.

Rigs Get Back To Work in West

Drilling rigs are fast getting back to work in western Canada after spring weather conditions forced the Governments of Alberta, Saskatchewan, Manitoba and British Columbia to issue "road bans" on the highways to protect them from the effects of heavy equipment moving on them. A special survey just completed reveals there are currently 234 rotaries active in western Canada and the Northwest Territories; while just 10 days ago there were only 170 in the active class.

Of the total number of rigs currently active in the area covered by the survey, 148 are working on field development tests and the other 86 are drilling or moving to new wildcat ventures. Activity is up in every area according to the compilation as Alberta's rate of activity increased during the 10-day period from 96 to a current 118; Saskatchewan showed 49 and now has 82 in the active class; Manitoba's almost tripled as the present survey shows 11 active as against 4, 10 days ago; and British Columbia's increased by 1 as it now has 22 rigs as against 21 at the date of the last survey. There is currently one rig active in exploration in the Northwest Territories.

QUEBEC

At Bald Mountain 2 Batiscan, 1,250 ft. southeast of the discovery well, drilling is proceeding below 2,055 ft. As the well is logging 20 ft. deeper than the discovery well, 7-in. casing will be set and cemented at 2,170 ft. and the gas zone is looked for at about 2,217 ft.

At Bald Mountain 1 Berthier, 58 miles southwest of the discovery well, at 2,131 ft. a gas zone was crossed which tested 212,000 cu. ft. per day, with a closed-in top hole pressure of 700 psi. Drilling is presently proceeding below 2,165 ft.

At Bald Mountain 2 Portneuf, 25¼ miles northeast of the discovery well, the well is down to 1,225 ft., and from now on will be drilled and tested in 15-ft. intervals.

At Bald Mountain 1 Cap Sante, 30¼ miles east-northeast of the discovery well, drilling is proceeding below 775 ft.

LOUISIANA

NORTH LOUISIANA

Salt Dome Discovery Flows Gas From Paluxy

The first indicated commercial production associated with salt domes in North Louisiana is reported at Pan American Petroleum Corp.'s 1 A. A. Hudson, C E½ NW NW 21-19n-8w, 4½ miles east of Minden off the east flank of the Minden Salt Dome in Webster Parish.

This northwestern Louisiana wildcat flowed 3,400 M.c.f. of gas and 50 bbl. of condensate per day on 19/64-in. choke from perforations in the Paluxy sand at 7,460-66 ft.

Pan American's well formerly flowed gas and condensate from the Cotton Valley at 9,490 to 9,612 ft. Total depth is 11,604 ft. in the salt.

North Louisiana's first indicated commercial production associated with a salt dome is reported at Pan American 1 Hudson in Webster Parish.

SOUTH LOUISIANA

Deep Gas Well Extends Lake Enfermer Field

Olin Gas Transmission Corp. and H. L. Hunt have completed another deep well for their Lake Enfermer field, in the marshes bordering the upper end of Caminada Bay, in Lafourche Parish.

It is their 1 Unit 7, productive of gas from perforations at 13,140-50 ft. with bottom of the hole at 13,247 ft. Tests rated the well good for 3,900,000 cu. ft. per day. Flowing pressure was 3,900 psi. Shut-in pressure is 4,800 ft.

Location is nearly 1 mile northwest of the field's discovery well, productive of gas and condensate from perforations at 13,000-08 ft. This well was completed in March 1955. Other wells drilled since then have been to the south and west.

The new gasser is the deepest to date.

South Duson Discovery Uncovers New Pay Zone

Sunray Mid-Continent Oil Co. and Buffalo Oil Co. are opening another productive zone in their steadily developing multiple-pay Duson field, southwestern Lafayette Parish.

It is in their 6 Mary McConnell, which tested 2,600,000 cu. ft. of gas and 29.7 bbl. of 45.5°-gravity condensate per day, flowing through 9/16-in. choke. The new pay is in the Frio-Meogypsinoides zone, perforated at 11,500-10 ft.

Two other potentially productive sands were logged in the well, which was drilled to 14,107 ft.

The well is on the south side of the field extending toward the same operators' Ridge area less than 1 mile further south.

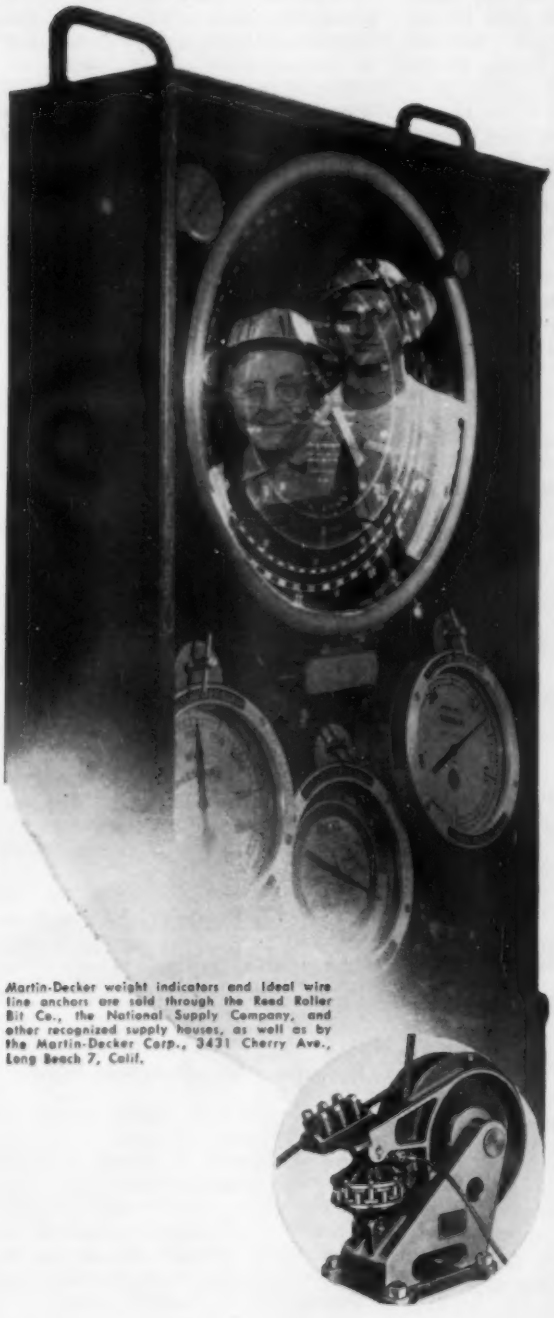
Gas Production Indicated In Paddy Bay Wildcat

California Co. has an indicated gas-condensate discovery-well in the Paddy Bay area in Plaquemines Parish's delta marshes east of the Mississippi River.

It is the company's 1-B State Lease 2938, in Township 22s-20e. The area borders Mississippi River's Pass Loutre outlet to the Gulf of Mexico.

Indicated production is from perforated interval at 12,151-55 ft. in hole drilled to 13,075 ft. The well was shut in after cleaning. Flow was not gaged and no estimate of production was made.

REFLECTIONS OF AN OLD-TIME DRILLER



Martin-Decker weight indicators and Ideal wire line anchors are sold through the Reed Roller Bit Co., the National Supply Company, and other recognized supply houses, as well as by the Martin-Decker Corp., 3431 Cherry Ave., Long Beach 7, Calif.

"Yeah, you're right, Jimmy, there sure are a lot of gauges to watch, but they're all necessary if you want to make hole fast and if you don't want to spend a couple days fishin'. And I don't mean for speckled trout.

"I remember 35 years ago when I was a weevil like you, you didn't see too many weight indicators on the old wooden rigs. And those you did see were pretty crude. That's probably why they didn't catch on so fast. Another reason was that a lot of the old-time drillers thought they were real hotshots who could drill by the seat of their pants.

"But a lot of things went haywire. Those guys were twistin' off their drillpipe like so much macaroni. They were drillin' crooked holes that snaked all over the oil patch. Sometimes they even bumped into one another. Something had to be done.

"In the late Twenties Martin-Decker came out with a weight indicator that was pretty good for its day. Simple enough. Just a hydraulic gauge that hung on the dead line. Later they built one that used copper tubing to connect the diaphragm on the dead line to a gauge right in front of the driller. But even that was a far cry from this Martin-Decker Type "D" drilling console standing in front of us here.

"This is the most accurate and dependable weight indicator anyone's come up with yet. It gets its hydraulic signal from an outfit called a 'Sensater,' which is locked into the Ideal wireline anchor. Remind me to take you under the rig and show you how the Sensater works. It's a clever gadget. It strokes just like a piston but – well, I'll show you later.

"The weight indicator has two pointers and two dials and shows the total drill-string weight and the net weight on the bit. The mud gauge tells you if you're getting enough pressure and circulation, the torque gauge tells you how much twisting power you're putting into your bit, the tachometer tells you how fast your rotary table is turning. A recorder makes a written record of the whole operation.

"New stuff comes out every year. Now they have electric recorders that can make a history of a job a long way off. They also have electric tachometers for rotary speed, pump pressure, and engine RPM. The ones I've seen are really slick. I'll sure be glad when they're standard equipment on all rigs – and they will be someday, mark my words.

"Yes sir, Jimmy, when you get to be a driller someday, all you'll have to do is push a mess of buttons to drill a whole oil well. But there'll be Martin-Decker instruments in front of you to tell you which buttons to press."

MARTIN-DECKER CORP.

HOME OF THE WEIGHT INDICATOR — LONG BEACH, CALIFORNIA

MICHIGAN

Three Offsets Staked At Gladwin Discovery

Three 20-acre offset locations were staked to the Muskegon Development Co. 1 State-Billings, SW SW SE 12-17n-1e, Billings Township, Gladwin County. Muskegon Development Co. staked locations in NE SW SE and SW SE SE 12-17n-1e, the diagonal northeast and the east 20-acre offsets. Socony Mobil Oil Co., Inc. staked location for the south 20-acre offset, in the NE NW NE 13-17n-1e. All three wells will be drilled immediately.

The 1 State-Billings, bottomed out in Dundee at 3,582 ft., has been flowing an average of 100 bbl. of oil a day in 3½ hours daily through a restricted choke. Wildcat is located about 2 miles southeast of the original Billings Dundee-"sour" oil pool.

● First final completion in the new Scipio Trenton pool, Scipio Township, Hillsdale County, was completed at Aurora Gasoline Co. and McClure Oil Co. 1 Rowe, SE NW NE 10-5s-3w. Well, good for 150 bbl. of oil a day, will be restricted to 120 bbl. daily at 3,939 ft., total depth. Well produces about 600 cu. ft. of gas per barrel of oil. Trenton top was logged at 3,565 ft. Best pay was probably drilled at 3,883-96 ft.

Annual Field Trip

The Michigan Basin Geological Society annual field trip will be June 14, 15, and 16. The trip will cover the Silurian section in the Northern Peninsula of Michigan, Manistique-St. Ignace area. The field trip will begin officially Friday morning at the Highway Motel in Manistique which will be headquarters Thursday night through Saturaday morning.

The cost of the guide book for members of the society, students, and field trip participants will be $3 and registration fee will be $1. The guide book is slated to come off the press by June 1.

MISSISSIPPI

Second Raleigh Producer Uncovers Deeper Oil Zone

California Co.'s second well in its new Lower Cretaceous field at Raleigh, in Smith County, not only is confirming the discovery of the field but is opening a deeper zone, The Hosston. Its discovery well was completed in Bailey (Sligo) sands.

Considering net effective sand and productive showing so far, the new Raleigh producer, Homer Currie et al, appears to be one of the best Lower Cretaceous wells in the state to date.

Location, in 28-2n-7e, is a half mile north of the discovery well (1 Central "5").

Completion is in 49 ft. of Hosston sand, perforated at 12,184-12,233 ft. Through the Rodessa, Pine Island, Sligo, and Hosston sections, the well logged a total of 251 ft. of net effective sand. The Hosston sand was the thickest.

Flow rate of the well has been increasing in successive tests. In the first 23 hours after being swabbed in, the well made 293 bbl. Later, on a 24-hour gage through 3/16-in. choke, it flowed 501 bbl., cutting only 0.4 per cent b.s. & w. Flowing pressure through that choke was 1,700 to 1,800 psi. Gravity of the oil is 45.1°.

The well was drilled to 12,398 ft. without encountering a definite water contact. From derrick-floor elevation of 340 ft., it topped Lower Cretaceous at 8,345 ft. It checked 70 ft. higher than the discovery well.

The latter well, completed last January in Bailey sand, perforated at 11,692-11,703 ft. and 11,758-64 ft., recently quit flowing, and has been put on the pump, making about 100 bbl. of oil per day.

Hosston Sand Discovery In Wayne County Complete

Official designation of the new Lower Cretaceous producing area opened by Larco Drilling Co. and Durbin Bond & Co. in northern Wayne County, in the eastern part of the state, is "Diamond" field.

The Larco and Durbin discovery well, 1 Gray Estate, in 7-9n-6w, has been completed with a potential gage of 168 bbl. of 38.4°-gravity oil per day, flowing through 7/64-in. choke. On this choke, its pressure was 770 psi., and gas-oil ratio 500 cu. ft. per barrel.

Production is from Hosston sand, perforated at 9,931-36 ft. Total depth is 10,020 ft.

This is Mississippi's fourth Lower Cretaceous discovery this year.

NEVADA

Wildcat Due 40 Miles South of Ely

Standard Oil Co. of California, Western Operations, Inc., is preparing to drill an exploratory well about 40 miles south of Ely, Nev., in conjunction with four other oil companies, it has been announced.

The new well, 1 County Line Unit, White Pine County, is being drilled jointly with Shell, Mohawk, Union and Richfield oil companies, with Standard as operator.

Site of the wildcat will be about 25 miles northwest of Shell's production in Railroad Valley, some 50 miles west of the Utah border.

OKLAHOMA

NORTHWESTERN OKLAHOMA

Ellis County Once More a Producer

Production has returned to Ellis County as a result of Shell Oil Co.'s 1 Peetoom discovery in NE NE SW 29-24n-25w, 10 miles south of Harper County's Laverne gas area.

Shell took final flow test at the well, getting 1,180 M.c.f. of gas per day from perforations in the Morrow-Pennsylvanian at 7,961-76 and 8,032-42 ft.

SOUTH-CENTRAL

Red Fork Is New Pay At West Moore field

West Moore field in Cleveland County has a new pay, the Red Fork sand of Pennsylvanian age. The discovery well is An-Son Petroleum Co. and Hershey Oil Co. 2 Hoover, C NE SE 21-10n-3w.

The well flowed 538 bbl. per day on ¼-in. choke from perforations at 7,676-82 ft.; 287 bbl. from the Bartlesville sand, another basal Pennsylvanian pay at 7,744-62 ft. on 18/64-in. choke.

Second Well Added to Renewed Washington Play

The renewal of drilling activity in the Washington field area of McClain County counted its second producer last week. Anderson-Prichard Oil Corp. 1 Westbrook, C SW SW 3-7n-3w, flowed 220 bbl. of oil in 4 hours on ½-in. choke and 191 bbl. per day on 10/64-in. choke from Bromide sand perforations at 10,470-95 ft.

ROCKY MOUNTAIN

UTAH

Paradox Roundup

Carter Oil Co. reported details on a third drill-stem test at the 1 Navajo-114 discovery in SW NW NW 8-41s-

25e, San Juan County. This wildcat flowed 380 bbl. of oil per day on a test at 5,531-92 ft. Earlier, at 5,466-5,560 ft., the well flowed at the rate of 1,109 bbl. per day. This wildcat is about 1½ miles south of a Superior Oil Co. discovery well in 31-40s-25e.

● At Aneth itself Carter completed the 1 Hickman Federal, a 1-mile northwest stepout to Aneth in C SE SW 1-40s-23e. This one flowed 1,252 bbl. per day on 2½-in. tubing. Production is from upper Hermosa or Bluff zone at 6,144-64 ft. Gravity of the oil is 42°.

● The southwest offset well to "East Desert Creek" field, Continental Oil Co. 1 Indian, C SW NE 27-41s-24e, flowed 151 bbl. of clean oil on latest tests of perforations at 5,505-22, 5,256-50, 5,478-5,504, and 5,550-70 ft. This well gives the area its third producer. Superior confirmed the Davis Oil Co. discovery at 1 Navajo-E, C SW SW 23-41s-24e, for 770 bbl. per day on 24/64-in. choke. The Davis Oil Co. discovery is in 27-41s-24e.

Important Link Discovery Completed By Continental

Continental Oil Co. completed its important link discovery at 1 Navajo-H, C SW SE 21-40s-25e, San Juan County. The well flowed 192 bbl. of oil daily on ⅜-in. choke from Paradox-Pennsylvanian perforations at 5,930-52 ft. This well is over 2 miles east of Aneth and is separated from that field by dry hole and also by one to the east from East Aneth field.

COLORADO

State Has New Depth Record at Phillips Well

A Phillips Petroleum Co. wildcat at Powell Park in Rio Blanco County is below 15,368 ft., breaking the existing drilling-depth record for Colorado which was 15,041 ft. at Hiawatha in Moffat County (Mountain Fuel 1 Unit). The new well, 1 Mannel, NW NW NE 27-1n-95w, is planned to hit the Weber at 17,000 ft.

WYOMING

Wyoming Field Trip Announced

The Twelfth Annual Field Conference of the Wyoming Geological Association will be held in the southwestern Wind River basin September 12-14, with headquarters in Lander, Wyo. A symposium will be combined with short field trips to explore the theme: Factors affecting the migratio nand accumulation of oil.

Technical sessions will be held each morning in Lander. Field trips will then be taken to illustrative locations in the conference area, which is in general bounded by the Wind River Mountains, Winkleman Dome oil field, the Rattlesnake Mountains, and Bison Basin oil field.

Reservation blanks and detailed information may be obtained by contacting Mike S. Johnson, Box 2249, Casper, Wyo.

TEXAS

NORTH TEXAS

Young County Gets Strawn, Mississippian Discoveries

Young County last week gained two good flowing wells. Operators of each have asked for discovery allowables.

In south-central Young, J. W. Hastings 4 Holcomb "C" opened Strawn production in a Caddo producing area From open-hole section at 2,686-92 ft., the well flowed 126 bbl. of 41° oil in 24 hours. Choke on tubing was 10/64-in., tubing pressure was 180 psi. and gas-oil ratio was 720:1.

Location of 4 Holcomb is in the

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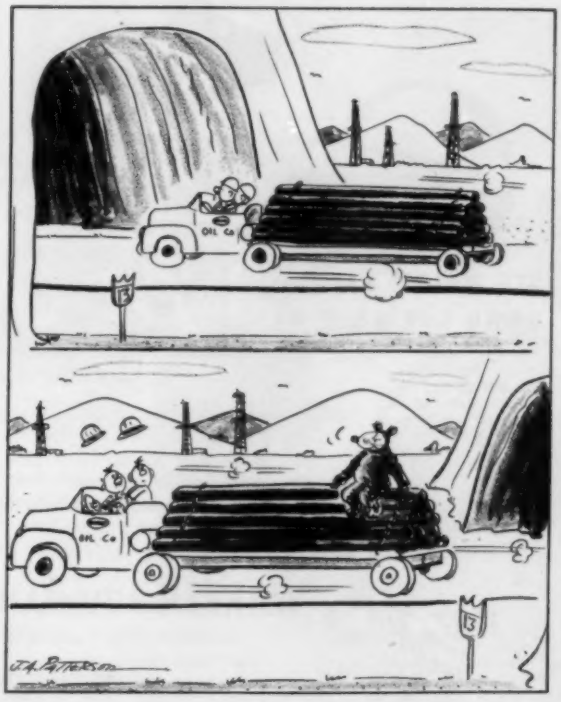
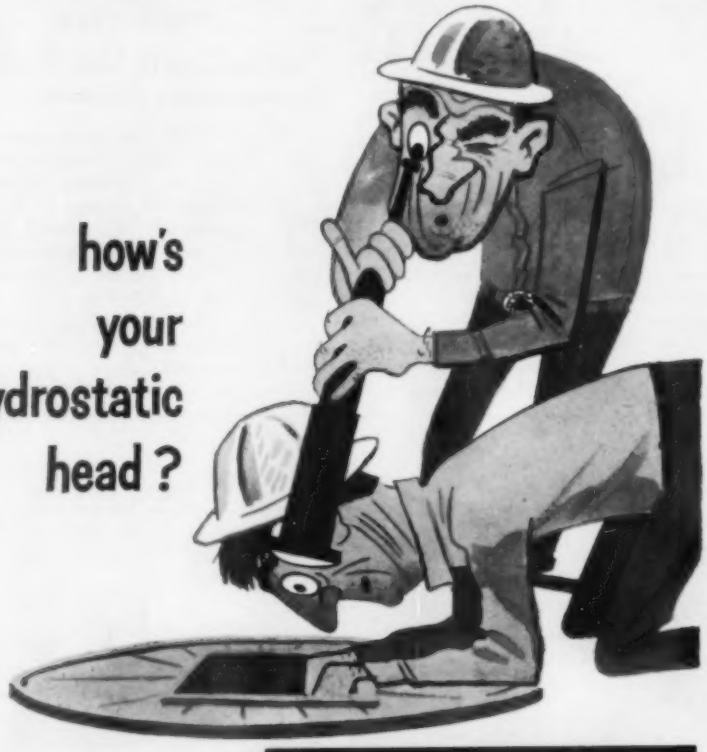


R. J. Fisher Survey, A-94, 7½ miles west of Graham, and slightly more than ½ mile southwest of nearest production in Hunter Holcomb field.

The Mississippian discovery was Armour Properties 1 Carmack Trust, 3 miles northwest of Murray townsite, in Block 26, Young CSL Survey. On completion test the well made 236 bbl. of 44° oil a day through 10/64-in. choke, from perforations at 4,432-40 ft. Flowing pressure was 400 psi. on tubing. Gas-oil ratio was 620:1. The same operators have made location for 2 Carmack Trust as an east offset to the discovery.

Knox County . . . Katz Oil Co. has completed its 1 John M. Wylie as a Strawn discovery. Location is 2 miles northwest of Knox City townsite and 1½ miles southwest of North Knox City field. Initial potential was 110.8 bbl. of 37.5° oil a day, flowing through 18/64-in. choke. Tubing pressure was 50 psi. and gas-oil ratio 175:1.

Montague extension . . . Bennett Oil Co. has filed corrected potential for its 1 Carrie Lyons, 1-mile west extension to the Arias Caddo field in southern Montague County. The well flowed 198.3 bbl. of oil in 6 hours through 16/64-in. choke, to give it a daily potential of 793 bbl. Two-inch tubing was set at 5,996 ft.



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SOUTHWEST TEXAS

Val Verde's Deepest Test Fails to Get Production

Val Verde County's deepest test, a rank wildcat, is being plugged as a failure.

It is Humble Oil & Refining Co.'s 1 Mills Mineral Trust, in Section 128, Block 1, I&GN Survey, 2 miles northwest of Pandale, in the northwestern part of the county.

At 17,511 ft., no significant showings of oil or gas had been reported.

Previous deepest test in the county was Phillips Petroleum Co.'s 1 Wilson, drilled in 1952 to 16,445 ft. It was in the Vinegarone Strawn-sand (10,000-ft.) gas area, 45 miles east in the northeastern part of the county.

Nearest production is a shut-in Ellenburger gas well located more than 10 miles northeast near the Crockett county line. It was completed in April 1956 by Magnolia Petroleum Co. from a 14,000-ft. zone after drilling to 15,143 ft.

TEXAS PANHANDLE

Panhandle's Deepest Hole Is Tonkawa Gas Discovery

The deepest hole in the Texas Panhandle was completed up the hole as a Tonkawa-Pennsylvanian gas discovery. The well, Magnolia Petroleum Co. 1 Feldman, 10 miles east of Glazier in Hemphill County, went to 15,977 ft., plugged back to 7,700 ft., and was completed flowing 7,000 M.c.f. of gas per day, calculated open flow, with 3 bbl. of distillate per million. Perforations are at 7,556-96 ft.

Magnolia's deep well is located in Section 43, Block 42, H&TC Survey.

WEST TEXAS

Sandy Lime Spraberry Is First in Midland Area

A Spraberry discovery in central Midland County attracted attention last week as the first Spraberry "limestone" well for that area. Operators said the Spraberry limes up to the north, and described the pay as sandy lime.

The well is Skelly Oil Co. and Atlantic 1-S Texas, 6 miles northeast of Andrews, and 20 miles northwest of the Glass-Spraberry fields in southwestern Martin County. Location is NE NW Section 8, Block 3, University Lands Survey.

Skelly and Atlantic's sandy lime Spraberry discovery in Andrews County is the first for that area. Nearest comparable production is in Glass fields in Martin County.

Completion potential was 221 bbl. of 36° oil, plus 5 bbl. of water, through ½-in. tubing choke. Perforations were in the Lower Spraberry at 9,266-85 and 9,228-45 ft. Acid treatment consisted of regular mud-acid only.

The discovery was drilled to 13,274 ft., total depth. Formation markers were: Spraberry 8,490 ft., Pennsylvanian 10,020 ft., Mississippian 11,787 ft., and the McKee at 13,840 ft.

Spraberry opener in Dawson County . . . Camp Oil Co. and J. E. Jones Drilling Co. 1 A. B. Middleton has opened a new Spraberry pool about 2½ miles west of the West Spraberry field, in eastern Dawson County.

The opener, or long extension, completed for 115 bbl. of 39° oil a day from perforations in the Spraberry at 7,377-79 and 7,383-91 ft. Gas-oil ratio was 390:1. Completion was by fracturing.

Location is 6 miles southeast of Lamesa, in NW SE 30-34-T5N-T&P Survey. Total depth was 8,830 ft., in reef limestone, which was dry. West Spraberry field has several wells producing from Canyon reef limestone.

Crane County completion . . . Gulf Oil Corp. 1 Adams, deep well in McElroy field, has been completed as a Permo-Pennsylvanian discovery. Calculated potention was 1,891 bbl. of oil a day, based on a 6-hour flow of 473 bbl. through 15/64-in. choke. Pay was perforated at 7,710-60 ft. Total depth was 11,400 ft. Location is NE NW 12-B24-PSL Survey.

Scurry County recompletion . . . Lone Star Producing Co. 1-T Evans estate, 1 mile north of Snyder in 156-3-H&GN Survey, has been completed as a Strawn discovery. Potential was 124 bbl. of 39° oil a day through 16/64-in. choke. Pay was perforated at 7,134-42 ft. after drilling out from old total depth of 7,275 ft., to 7,287 ft.

Successful Wildcats

ALBERTA

B.A. 11 Keindle, LSD 11, 33-37-24w4. TD 4,681 ft. Viking oil well.

BRITISH COLUMBIA

Imperial Pacific 1-23 Alces, LSD 1, 23-84-14w6. TD 4,516 ft. Triassic oil well.

CALIFORNIA

Kern County: M. J. M. & M. Oil Co. 3 USL-Snow, SE NW 4-28s-27e, 200 BOPD, 50 bbl. net, 12° gravity, perfs. 2,245-2,348 ft. TD 2,450 ft. (New fault block discovery in Poso Creek field).

Richfield Oil Corp. 61-25 ROC-KCL G NW NW 25-11n-20w, 17 BOPD, 20 per cent cut, 48.3° gravity, perfs. 8,445-8,505 ft. TD 9,710 ft. (New pool discovery 2½ miles east of regular production.)

COLORADO

Garfield County: Gulf Oil Corp. 2 South Canyon Federal, C SW NE 35-6s-164w. IP 2,100 M.c.f. of gas per day, Dakota discovery, new field. TD 4,162 ft. Morrison.

MICHIGAN

Allegan County: Louis Zellman 4 B. Zellman, NW SE NE 25-4n-13w. IPF 65 BOPD and 200,000 cu. ft. gas from Salina A-2 dolomite pay, 2,758-65 ft. TD 2,913 ft., PBTD 2,800 ft. (New pay in Dorr pool.)

Gladwin County: Muskegon Development Co. 1 State-Billings, SW SW SE 12-17n-1e. Dundee 3,454 ft., pay 3,540-45 and 3,555-58 ft., 100 BOD, restricted flow, TD 3,582 ft. (New pool—or possibly major extensions of Billings field.)

MONTANA

Fallon County: Mobil Producing Co. 11-M-1-NP, S½ NW NW 1-7n-59e. IPP 155 BOPD, 107 BWPD, Mission Canyon discovery, new pay. TD 7,260 ft. Mission Canyon.

MISSISSIPPI

Wayne County: Larco Drilling Co. and Durbin Bond & Co. 1 Gray Estate, 7-9n-63.

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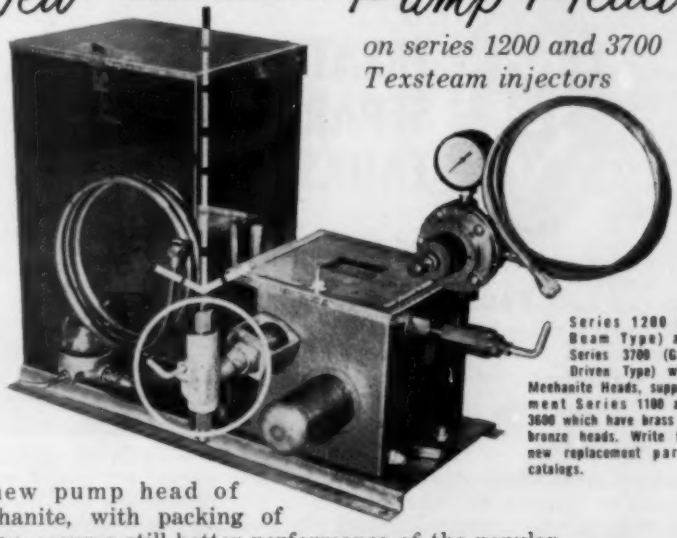

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NEBRASKA

Kimball County: Murfin & Sutton Drilling Co. 1 Nelson, C NW SW 31-14n-53w. IPF 175 BOPD, "J" sand discovery, new field. TD 5,958 ft. Skull Creek.

NORTH TEXAS

Cooke County: Concho Petroleum Co. 2 Steed "B," D. A. Noble Sur., A-1421, 2½ miles S. Callisburg. IP 66 BOPD, 10/64-in., 45°, GOR 135, TP 110 psi., Strawn 2,678-82 ft. TD 2,685 ft.

Knox County: Arnold H. Bruner & Co. 1 Reeves, 75-2-D&W, 1 mile SE Voss-Tannehill field. IPP 47 BOPD, pay 1,962-68 ft. TD 2,009 ft.

Wilbarger County: Lloyd Patton 1 W. T. Waggoner estate "S," 7 miles SW Harrold. IPP 84 BOPD, 41°, GOR 300, pay 2,388 ft. TD 2,392 ft.

SOUTHWEST TEXAS

Hidalgo County: Geochemical Surveys 1 Waters, Sec. 65, Blk. 1, Brown Tract Sur. (6½ miles south of Donna). IP 3,800 M.c.f. daily, open flow GLR 246.9 M.c.f. per barrel, 56.1°, perfs. 5,970-78 ft. TD 8,652 ft. (New field).

TEXAS GULF COAST

Colorado County: Christie, Mitchell & Mitchell 1 Peckham, I&GN Sur., A-323, Sec. 46 (1 mile southeast of Garwood). IP 1,080 M.c.f. daily, dry gas, shut-in pressure 900 psi., perfs. 2,098-2,106 ft. (Miocene). TD 3,804 ft. (New pay in Garwood field.)

Chambers County: The Texas Co. 1 Jackson Oil Unit 1-A, Edward T. Branch Sur., A-40. IP 1,050 M.c.f. daily, 78.6 BC per M.M.c.f., 3/32-in., 49.4°, TP 8,326 psi., perfs. 12,660-80 ft. (Frio). TD 13,514 ft. (Second well and new pay in East Smith's Point field.)

Harris County: Oil & Gas Property Management, Inc., 1 Wise, WCRR Co., Sur., A-920, Sec. 3, Blk. 1 (2½ miles southeast of Satsuma). Shut-in gas well (estimated 1,500 M.c.f. daily, 5/32-in.), perfs. 7,620-26 ft. (Yegua). TD 7,925 ft. (New pay in Satsuma field.)

Kenedy County: The Texas Co. 13 Yturria-NCT-1, Share 2, San Juan de Carricitos Jose Narciso Cabazos Grant, A-8. IP 4,900 M.c.f. daily, open flow, GLR 152.7 M.c.f. per barrel, 55.3°, perfs. 7,359-66 ft. (Frio). TD 7,500 ft. (New pay in Monte Pasture field.)

Kleberg County: Arkansas Fuel Oil Corp. 1 Reitsch, Sec. 10, T. F. Kochs First Subd., Riviera Lands, Gabriel Trevino Sur., A-232. IP 300 M.c.f. daily, open flow, GLR 0.55 cu. ft. per barrel, 74.1°, perfs. 6,668-83 ft. (Yegua). TD 9,517 ft. (New pay in East May field.)

Newton County: Chessher Sutton & Davis Drilling Co. 1-B H. L. Brown, J. Henderson Sur, 10, A-180. I.P. 140,000 M.c.f. daily, open flow, GLR 50 M.c.f. per barrel, perfs. 7,472-75 ft. (Hackberry). TD 7,640 ft. (New pay in West Hartburg field.)

WEST CENTRAL TEXAS

Brown County: J. T. Watts 1 Mollye Kilgore, Robert Mitchell Sur. 141, 4 miles SE Cross Cut. IPP 25 BOPD, 36°, pay 1,120 ft. TD 1,137 ft.

Jones County: C. M. Hassinger 1 Elmer Holland, Martinez Sur. 195, 2 miles NW Hawley. IPP 126 BOPD, 37°, GOR 590, Tannehill 1,974-82 ft. TD 2,130 ft.

Nolan County: Union Oil Co. of California 1-74 Sproul, 74-22-T&P, 4 miles S Sweetwater. IP 197 BOPD, 16/64-in., 40°, GOR 1582, TP 500 psi., pay 6,077-95 ft. TD 6,165 ft.

Shackelford County: Van Grisso Oil Co. 2 Walker-Buckler Trust, 72-3-T&P, 11 miles SW Albany. IP 194 BO in 22 hours, ½-in., TP 1150 psi., GOR 815, 41°, Gardner sand 3,903 ft., TD 3,913 ft.

Stephens County: Cherry Brothers 1 Corbett, SPRR Sur., A-1772, 3 miles S South Bend. IP 138 BOPD, 16/64-in., 45°, GOR 1770, TP 620 psi., pay 4,036 ft. TD 4,442 ft.

Stonewall County: DeSoto Oil Co. 1-A Link, 123-D-H&TC, 1 mile S Aspermont. IP 119 BOPD, 10/64-in., 41°, GOR 200, TP 355 psi., Canyon reef 4,981 ft. TD 4,991 ft.

WEST TEXAS

Dawson County: Hunt Oil Co. 1 Frank Freeman (formerly Skelly Oil Co. 1 Freeman), Labor 11, League 275, Glasscock CSL Sur., 9 miles SW Lamesa. IP 55 BOPD, ¾-in., 35.7°, TP 25 psi., Pennsylvanian perfs. 11,159-73 ft. TD 12,885 ft. Elev. 2,988 ft.

Ward County: Cosden Petroleum Corp. 1 University, 37-17-University Lands, 9 miles NE Pyote. IP 155 BOPD, 20/64-in., 37°, Delaware pay 5,044-68 ft. TD 5,120 ft.

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SOUTH LOUISIANA

Allen Parish: H. L. Hunt et al 1 Hodges, 24-5s-5w (4 miles northeast of Harmony Chuech field). IP 193 BOPD, 1,024 M.c.f. daily, 5/32-in., 57.5°, GOR 1,024 cu. ft. per bbl., TP 3,350 psi., perforations 9,442-46 ft. TD 10,008 ft. (New field.)

Iberia Parish: Berkshire Oil Co. 1 Berkshire-Jeanerette, 12-12s-10e. IP 65 BOPD, 2,700 M.c.f. daily, 11/64-in., 49°, GOR 41,540 cu. ft. per bbl., TP 4,125 psi., perforations unreported, TD 12,315 ft. (Extension midway between Bayou Pigeon and Little Bayou Pigeon fields.)

Lafourche Parish: Monterey Oil Co. 2 Bowie, 116-15s-18e. IP 200 BOPD, 3,400 M.c.f. daily, 7/32-in., 49.9°, GOR 17 M.c.f. per bbl., TP 3,600 psi., perforations 12-996-13,004 ft. TD 13,004 ft. (New pay in Lake Boeuf field.)

Sinclair Oil & Gas Co. 2-A OCS-0605, Block 86, South Timbalier area, Gulf of Mexico. IP 321 BOPD, ¼-in., 33°, GOR 900 cu. ft. per bbl., TP 650 psi., perforations 12,838-66 ft. TD 12,970 ft. (Second well and new pay in South Timbalier Block 86 field.)

Plaquemines Parish: California Co. 1 OCS-0378 (State Lease 1275), Block 58, Main Pass area, Breton Sound. IP 174 BOPD, 9/64-in., 23.1°, GOR 161 cu. ft. per bbl., TP 525 psi., perforations 6,848-52 ft. TD 9,004 ft. (New offshore field.)

WYOMING

Crook County: Glenwood Oil Co. 1 Foster, SW NW NW 10-49n-65w. IPP 15 BOPD, Lakota discovery, new field. TD 401 ft. Lakota.

Signal's choice is Curtice:

Foreign Expert in a New Role

ARTHUR A. (DUKE) CURTICE has carved out a career in oil that reads like a movie scenario. It extends from wartime aviator, teacher, and geologist, to oil operator in many parts of the world.

At 59, Curtice is still adding to the story. His latest job is one that fits him admirably. He's president of Signal Exploration Co., new Venezuelan subsidary of Signal Oil & Gas Co.

When Signal decided to go into Venezuela, it created the subsidiary in Caracas to handle the activity. Then Signal officers went searching for an executive who could get the enterprise off the ground. They picked out Curtice.

In Curtice, Signal acquired a man who knows Venezuela from first-hand experience; he helped write the country's present oil law.

Curtice was named to the post early last month and will get things under way in Caracas this month. He will direct operations initially on a 27,000-acre lease on Lake Maracaibo. Signal obtained the spread jointly with Standard Oil Co. (Ohio), Hancock Oil Co., and Pure Oil Co. Signal Exploration will be the operator.

Curtice plans to start the first well in May. It probably will be a 12,000-ft. test, drilled in about 110 ft. of water.

A good teacher . . . Curtice began his travels early.

He was born in Webster, N. Y., in 1897, but on his second birthday—July 4, 1899—his family moved to Spokane. He stayed there until 1915 when he journeyed south to Stanford University.

Except for a brief stint in naval aviation in World War I, Curtice stayed at Stanford long enough to collect a degree in geology. He also received a Herbert Hoover fellowship in graduate mining.

During 1920 and 1921 he taught field geology in Stanford's summer school. Among his students were Lloyd L. Aubert, now president of Bankline Oil Co.; R. O. Rhoades, senior vice president of Gulf Oil Corp., and Dr. Pedro Aguerrevere, former Minister de Fomento, Venezuela.

First discovery . . . In 1921 Curtice joined the staff of Robert B. Moran, consulting geologist in Los Angeles.

There Curtice put together the land and worked up the geology that resulted in Ohio Oil Co.'s discovery of Playa del Rey field in 1929.

In 1930 Curtice opened an office in Los Angeles as a consulting geologist with Moran.

The Argentine Government hired him in 1939 to head a special commission to study various areas in Patagonia. He was charged also with teaching a couple of aspiring South American geologists U. S. field techniques.

His pupils learned their lessons well. Enrique T. Mauri later became director of exploration for Yacimientos Petroliferos Fiscales of Bolivia. The other, Juan J. Zunino, later held a similar position in Argentina.

In 1942, with Herbert Hoover, Jr., Curtice helped prepare Venezuela's 1943 Law of Hydrocarbons. It has since served as a model oil law for a number of other countries.

The firm of Hoover, Curtice & Ruby (Glen Ruby) did the work which led to the discovery of Spring Hill oil field on December 4, 1945, in southern Chile on the Straits of Magellan.

Interests afar . . . Curtice's work continued to take him into faraway spots.

With Hoover, he served as advisor on petroleum matters to the prime minister of Iran (1944) and to President Dutra of Brazil (1947). He also prepared the first draft of what later became Peru's oil law.

Hoover, Curtice & Ruby, through a partially owned subsidiary, Arctic Contractors, managed the exploration campaign on Naval Petroleum Reserve No. 4 at Point Barrow, Alaska, for the U. S. Navy.

In 1949 Curtice joined Conorada Petroleum Corp. as president. He acquired extensive concessions for the company in Egypt and in British Somaliland. He also negotiated a joint operation between Conorada and Sinclair Oil Corp. in Italian Somaliland, and obtained other concessions in Peru and Libya.

From 1954 until his appointment as president of Signal Exploration, Curtice was a consultant for the Conorada group on Venezuelan matters with offices in Caracas.

His personal interests in Venezuela date back to 1945 when he, Hoover and Ruby, together with Dowell Incorporated, set up United Oilwell Service, S.A., to make Dowell services available in Venezuela.

J. E. Baugh, drilling and production superintendent for Canadian Fina Oil, Ltd., has been named exploitation manager of the company in Calgary. Baugh has been with Canadian Fina since 1953.

W. F. Hand has been appointed manager of crude-oil purchasing for Canadian Husky Oil, Ltd. Hand succeeds **J. A. Cameron,** who recently joined Prairie Pipe Manufacturing Co., Ltd., of Regina. **G. C. Sutherland** will replace Hand as light-oil sales manager, western region.

Personals

G. L. MACIULA

G. L. Maciula has been named chief engineer of Service Pipe Line Co. Maciula was formerly assistant Missouri-Illinois division manager in Raytown, Mo. As chief engineer he succeeds **A. H. Newberg,** who will resign June 30 to enter the Episcopal ministry. **Ellis Orr,** superintendent of the company's Drumright, Okla., district, will succeed Maciula as assistant Missouri-Illinois division manager. Maciula joined Service in 1946. He was assistant manager of the Oklahoma division and of the old Illinois division before being named assistant manager of the Missouri-Illinois division last year. Newberg has been with Service since 1945 and was appointed chief engineer in 1947. Orr joined the company in 1933. He has been Drumright district superintendent since 1950.

D. D. Bills, area geologist in Casper, Wyo., for Champlin Oil & Refining Co., has been transferred to Calgary to open offices for Champlin. **Merle Hicks,** geologist in Casper, will replace Bills as area geologist.

W. W. Sabin has been appointed supervisor of refinery operations at Ethyl Corp.'s Detroit laboratories. **Frank V. Canfield** has been named supervisor of process design and **Richard A. Ashby** has joined the company as a research chemist.

John H. Thacher, vice president in charge of exploration and production research for California Research Corp., has been named president of Iran California Oil Co., subsidiary of Standard Oil Co. of California which manages its interests in the Iranian consortium. He succeeds **S. Z. Natcher,** recently named head of Standard of California's public-relations department.

George J. Hanks, president of South Penn Oil Co., has announced that he will retire before the next stockholders' meeting in May 1958. Hanks was a vice president and director of Tidewater Oil Co. before joining South Penn in 1944 as executive vice president. He was elected president of South Penn soon after joining the company and was named chairman of the board in 1953. After the merger of Pennzoil and South Penn in 1955, Hanks was elected president of South Penn.

A. E. Pettit has been promoted by Sohio Petroleum Co. to exploration superintendent of the offshore district. He was formerly offshore district staff geologist.

Edwin T. Dibble has been transferred by Atlantic Refining Co. from Dallas to Midland, Tex., as geologist. **Robert D. Coffee** and **John R. Gunter, Jr.,** have been named associate research engineers for the company in Dallas.

James A. Perkins, Jr., and **Julian W. Quinn** have formed Perkins & Quinn Petroleum Engineering Consultants in Houston. Perkins was formerly division reservoir engineer with Gulf Oil Corp., and Quinn was chief of Gulf's reserves group.

J. B. Eaton, Jr., assistant superintendent of Texas Gas Transmission Corp.'s compressor station department, has been named superintendent. Eaton moves up to succeed **J. Ray Fisher,** compressor station superintendent since 1949, who has retired. Fisher will remain as a consultant to Texas Gas. Eaton joined Memphis Natural Gas Co., predecessor of Texas Gas, in 1948. He was superintendent of compressor operations in the southern division of the company before becoming assistant department superintendent in 1949.

Duane S. Goodnigh, Magnolia Petroleum Co. geologist, has been transferred to Oklahoma City from Mount Vernon, Ill.

Clark Adams has been named a research associate and **Ken Draeger** an engineering associate at the Baton Rouge, La., refineries of Esso Research & Engineering Co.

Paul H. Brandenstein, drilling superintendent for E. F. Moran, Inc., Tulsa, has been named manager of the company's eastern division in Evansville, Ind. Brandenstein succeeds **F. D. Harmon,** who will retire this week.

D. L. WINSETT

D. L. Winsett, superintendent of Ohio Oil Co.'s Robinson, Ill., refinery, has been named refinery manager. Winsett succeeds **H. E. Handy,** who is on leave of absence. **B. B. Miller,** assistant superintendent of the Robinson refinery, will replace Winsett as superintendent, and **J. A. Coddington,** senior engineer for the company in Findlay, Ohio, has been named assistant superintendent succeeding Miller.

SMITH MORRIS JORDAN JOHNSON KENNEDY

Sinclair Oil & Gas Shifts Top Management

FIVE changes in the top management of Sinclair Oil & Gas Co. were announced last week.

H. B. Smith, president since 1953, has been elected chairman of the board. He will succeed H. L. Phillips, who will remain a director.

W. H. Morris was elected president to succeed Smith. Morris became the youngest vice president of the parent Sinclair Oil Corp. earlier this year, moving up from the presidency of Sinclair Pipe Line Co.

J. W. Jordan, executive vice president, was named to the new post of vice chairman of the board. In making this change Sinclair's directors created a second position of executive vice president.

J. N. Johnson, vice president and assistant to the president, was elected executive vice president for administration and a director of the company.

J. B. Kennedy, vice president and manager of the Houston division, was elected executive vice president for operations. He will continue as a director and will be transferred to Tulsa.

The changes will become effective June 1. The company described the changes as "staff expansion" and said they are due to the continued growth of the company.

Two executives not affected by the changes are D. R. Gearhart, a vice president and director who recently was elected president of Sinclair Canada Oil Co., and F. H. Rhees, a vice president and director who will continue in charge of production activities.

E. L. Walton has been named general manager of D. & D. Drilling Co., wholly owned Venezuelan subsidiary of Falcon Seaboard Drilling Co., Tulsa. **Mahlon A. Mundy** has been appointed

M. A. MUNDY

E. L. WALTON

drilling superintendent, and **Ernst Neipp** has been appointed office manager. The firm was bought by Falcon Seaboard in April. It formerly operated as Drosdat & Dotson, a partnership. The new appointments complete its integration into Falcon Seaboard, according to **T. N. Law,** Falcon Seaboard president.

Lou Davis, coordinator of raw material supply in the supply and distribution department of Esso Standard Oil Co.'s Bayway refinery, Linden, N. J., has transferred to International Petroleum Co. in Lima, Peru, as economic advisor to the refinery manager there. **Ernest Peterson** has been transferred from the company's Baltimore refinery to succeed Davis at Bayway.

Jerome J. O'Brien, Monterey Oil Co., vice president and manager of Mid-Continent operations, has been elected president of the Texas Independent Producers and Royalty Owners Association. He succeeds **A. E. Herrmann,** Amarillo, Tex., independent. Other officers elected at TIPRO's annual meeting last week are **Ridley Wheeler,** Fort Worth independent, secretary; **Vance Foster,** vice president of First National Bank of Dallas, treasurer; and **Harry C. Jones,** vice president of Carter-Jones Drilling Co., Kilgore, Tex., state membership chairman.

Fred W. Bartlett has been elected Socony Mobil Oil Co. vice president in charge of producing succeeding **John C. Case,** who will retire July 1. Bartlett was named a director of Socony Mobil in 1953. He joined the company in 1939 and has been chief geologist for Socony Mobil Oil Co. de Venezuela, assistant chief geologist for Socony Mobil, assistant to the vice president in charge of producing, and general manager of the producing department. Case joined Socony Mobil in 1912. He was elected a vice president in 1946 and was a director and member of the executive committee of Arabian American Oil Co. from 1953 to 1956.

J. E. Parsons has been named division geophysicist for Continental Oil Co. in Houston.

Oney S. Hervey has been named district geologist for Atlantic Refining Co. in Houston.

William Hare, geologist with Continental Oil Co. in Denver, has been transferred to Durango, Colo.

Jack H. McCollum, formerly geologist with New Drilling Co. in Denver, has opened consulting offices there.

W. J. Thompson, Continental Oil Co. geologist in Midland, Tex., has been named assistant to the manager, geological, in Houston.

D. H. Hushion, project engineer with Colorado Interstate Gas Co., has joined Alberta Gas Trunk Line Co. as assistant chief engineer.

A. V. Vitt has been moved up by Seaboard Oil Co. from assistant general manager to general manager of the firm's western division at Denver. He replaces **N. A. Rousselot** who has been placed on special assignment.

J. B. Saunders, president of Triangle Refineries, Inc., and a vice president of Texas Eastern Transmission Corp. and Atlas Processing Co. has been elected a senior vice president of Kerr-McGee Oil Industries, Inc. He will continue as president of Triangle, which was recently purchased by Kermac.

J. D. Moody, K. E. Rotegard, J. A. Hord, and **Eugene Hosford,** all of Gulf Oil Corp.'s Fort Worth division office, have been named managers of four new districts, formerly zones, at Midland, Amarillo, and Wichita Falls, Tex., and Roswell N. M., respectively. Moody formerly was assistant division exploration manager. Hord was division production geologist. Rotegard was supervisor of the budget, statistics, and organization department. Hosford was assistant division production manager. **Tom Q. Williams** will replace Rotegard. **R. C. Herron,** division geophysicist, is being transferred to Midland as assistant exploration manager there. **L. V. Lombardi** will move up from division geophysical interpretation supervisor to replace Herron. **G. R. Belt,** former seismic interpretation supervisor, takes over Lombardi's former position. **L. E. Warren** is being transferred to Amarillo from Midland as assistant district exploration manager. Gulf's four new district managers will be responsible for all exploration and production activities and service functions in their respective districts.

DEATHS

William T. Stevenson, 56, president of Texas Gas Transmission Corp., died of a heart attack last week at Owensboro, Ky. He was also chairman of a subsidiary, Texas Gas Exploration Corp., and was president of Western Kentucky Gas Co. and its subsidiary, Kentucky Gas, Inc.

John Henry Phelan, 79, Beaumont oil man and philanthropist, died May 19 in Beaumont. Phelan, with the late Frank Yount, was one of the founders of the old Yount Oil Co. In 1915 the two, with the late T. F. Rothwell, formed Yount-Lee Oil Co. Yount-Lee's sale in 1935 to Stanolind Oil & Gas Co. was at that time one of the country's largest financial transactions. Phelan was also a director of several companies including Norvell - Wilder Supply Co.

Jethrum W. Koonce, 59, vice president of Jones, O'Brien, Inc., Shreveport oil producers, died May 14 in Shreveport after a heart attack. Koonce was a past vice president, director, and member of the executive committee of Independent Petroleum Association of America.

Karl A. Bashara, 50, of Wheat Ridge, Colo., district superintendent for Anderson - Prichard Oil Corp., was killed recently in a freak accident in northern Colorado's Cliff field. He was hit by his own car when the parked vehicle rolled 100 ft. down an incline.

William Joseph O'Brien, 60, president and owner of Rex Drilling Co., and partner in O'Brien Brothers, Inc., Shreveport, died recently in Shreveport. O'Brien had been in the drilling business since the early 1920's.

Leo Carle McEvoy, Sr., 75, former Tulsa independent and retired director of communications of baseball's American League, died May 18 in St. Petersburg, Fla. McEvoy entered the oil business around 1913 in Okmulgee, Okla.

Leslie H. Gibson, 54, chief engineer of Shell Pipe Line Co., died May 17 in San Angelo, Tex. He had been with Shell 29 years.

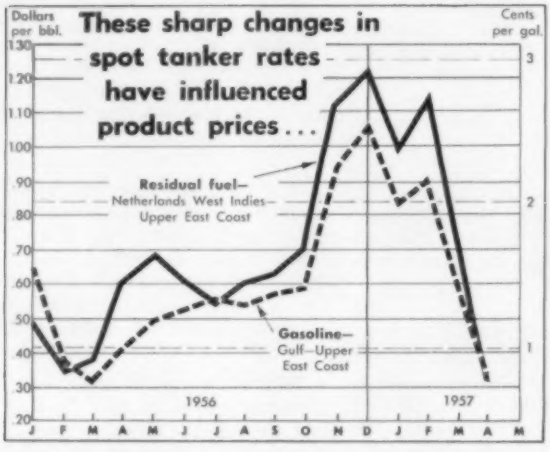
James R. Buck, Houston independent, died May 13 in Palm Springs, Calif., after a heart attack.

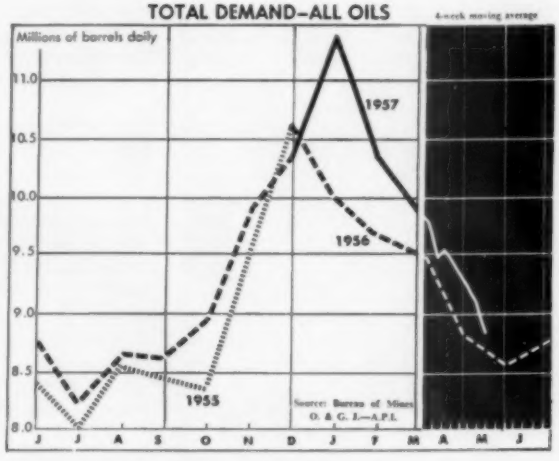
Don L. Bowersox, 42, Bakersfield, Calif., independent, died recently in Bakersfield.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,485,450	UP	63,025	UP	423,064
Crude stocks	261,876,000	DOWN	994,000	DOWN	11,730,000
Completions	984	DOWN	69	DOWN	253
Refinery runs	8,131,000	UP	81,000	UP	283,000
Gasoline stocks	196,383,000	DOWN	1,019,000	UP	9,527,000
Kerosine stocks	22,854,000	UP	947,000	UP	2,923,000
Distillate stocks	86,830,000	UP	4,570,000	UP	18,335,000
Residual stocks	39,426,000	UP	681,000	UP	6,012,000
Four-product stocks	345,493,000	UP	5,179,000	UP	36,797,000
Total imports	1,323,000	UP	37,400	DOWN	27,100


Dollars per bbl.
Cents per gal.
These sharp changes in spot tanker rates have influenced product prices . . .
Residual fuel—Netherlands West Indies—Upper East Coast
Gasoline—Gulf—Upper East Coast
1956
1957
J F M A M J J A S O N D J F M A M


TOTAL DEMAND—ALL OILS
Millions of barrels daily
4-week moving average
1957
1956
1955
Source: Bureau of Mines O. & G. J.—A.P.I.
J J A S O N D J F M A M J

Big Changes in Spot Tanker Rates Influence East Coast Product Prices

IT COST $1.05 a barrel less to move a cargo of residual fuel from the Gulf Coast to the East Coast in May than it did last December. The base rate for Gulf-East Coast movement is $2.85 a long ton or about 42 cents a barrel.

Last December the spot quotation moved up to 222.5 per cent above the base rate, due to the tanker shortage caused by the closing of the Suez Canal.

Petroleum demand in Europe eased somewhat with the coming of spring. Increased shipments from the U. S. Gulf Coast and Venezuela to Europe helped relieve the pressure on the tanker market. When pipeline movement from Iraq to the eastern Mediterranean was resumed, tanker demand was almost back to normal. The reopening of the Suez Canal resulted in a temporary surplus of tankers, and spot tanker rates tumbled.

The difference between cargo prices on the Gulf Coast and in New York Harbor represents transportation costs. Barge prices in New York Harbor don't change with every shift in tanker rates, but will yield to pressure from unusual variations in transportation costs.

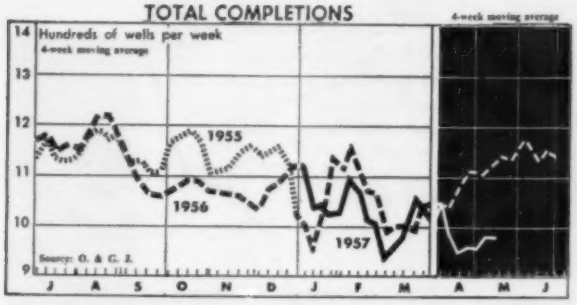
In normal times, movement by spot tankers may represent no more than 10 per cent of total liftings of crude and products, but abnormal changes in supply sources will tend to increase the portion moved in spot-charter tankers.

The chart, left above, shows the sharp increase in spot rates, starting in November after the closing of the Suez Canal. All of the gain and more was lost in March and April. Recent reductions in East Coast prices reflected both lower tanker rates and soft fuel markets on the Gulf Coast.

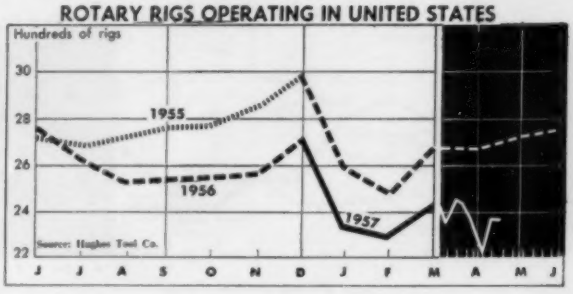
Premium gasoline up, octane and price . . . Group 3 quotations on premium gasoline in the Great Lakes Pipe Line are moving up a cent a gallon by areas. New premium, testing 98 octane, started in the line on the first of May. As soon as the new material is available at a terminal, the new price will go into effect.

This condition of two grades and two prices will continue until the new premium is available at all terminals, which will be after the first of June.

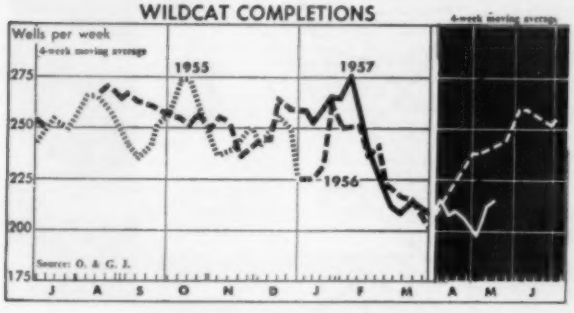
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	5-20-57	5-13-57	5-21-56
North Central and East	114	127	140
Southeast	45	41	28
Okla., Kans., Ark., Mo.	411	427	503
Louisiana	430	419	439
North and East Texas-Panhandle	347	327	447
Gulf and South Texas	207	206	270
West Texas-New Mexico	504	514	557
Rocky Mountain	229	228	256
Pacific Coast	92	94	128
Total United States	2,379	2,383	2,768
Canada	182	160	198

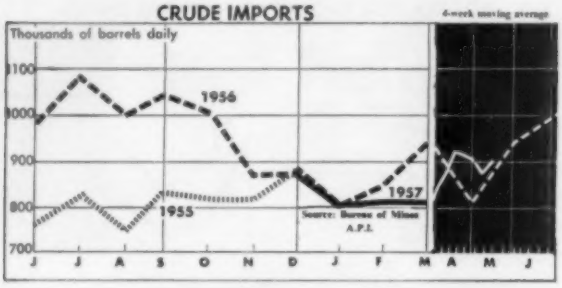
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MAY 18, 1957

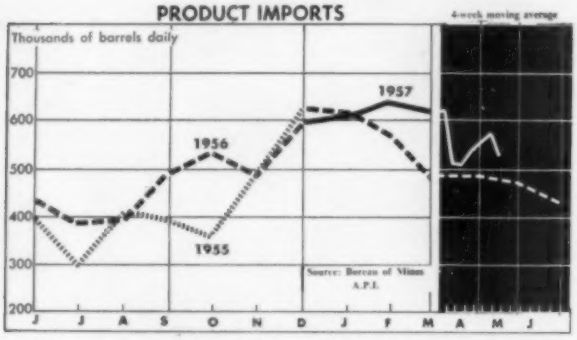
	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	†3	2	0	1	25,058	46	39	0	0	0	1	1	0	0	1	17	18
Arkansas	12	5	0	7	39,405	364	298	0	0	0	2	2	7	0	2	48	57
California	50	38	1	11	229,336	807	820	2	0	0	9	11	24	0	2	173	199
Colorado	11	1	1	9	60,884	345	442	0	0	1	8	9	13	0	7	212	232
Illinois	37	18	0	19	83,905	870	1,347	0	0	0	8	8	11	0	1	201	213
Indiana	14	5	1	8	16,433	231	231	0	0	0	3	3	4	0	0	43	47
Kansas	86	40	4	42	297,707	1,579	1,927	1	0	0	19	20	44	0	10	242	296
Kentucky	20	11	5	4	34,304	509	637	0	0	0	1	1	12	0	4	88	104
Louisiana	71	40	12	19	605,058	1,430	1,461	2	0	3	12	17	32	9	37	181	259
North	19	10	4	5	72,853	486	563	0	0	1	3	4	4	0	3	47	54
South	36	17	5	14	368,388	675	715	0	0	2	9	11	19	8	28	115	170
Offshore	16	13	3	0	163,817	269	183	2	0	0	0	2	9	1	6	19	35
Michigan	9	4	0	5	27,103	151	171	1	0	0	3	4	5	0	0	58	63
Mississippi	9	2	0	7	70,743	140	171	1	0	0	4	5	8	0	0	56	64
Montana	8	3	0	5	39,599	123	122	0	0	0	4	4	3	0	0	42	45
Nebraska	16	3	0	13	91,009	298	361	0	0	0	11	11	16	0	0	150	166
New Mexico	32	18	7	7	118,771	745	673	0	0	0	2	2	27	1	6	72	106
Northwest	15	5	7	3	62,796	272	228	0	0	0	1	1	12	1	5	24	42
Southeast	17	13	0	4	55,975	473	445	0	0	0	1	1	15	0	1	48	64
New York	9	4	0	‡5	9,250	177	.....	0	0	0	0	0	0	0	1	0	1
North Dakota	5	3	0	2	37,259	107	87	0	0	0	2	2	5	0	0	37	42
Ohio	23	18	2	§3	61,960	392	391	0	0	0	0	0	0	0	0	3	3
Oklahoma	95	63	4	¶28	326,644	2,484	3,373	3	1	0	2	6	39	9	6	226	280
Pennsylvania	13	0	9	4	81,516	337	*406	0	0	0	1	1	0	0	14	19	33
Texas	426	248	25	153	1,718,725	8,327	8,322	7	3	8	87	105	247	26	83	1,812	2,168
Southwest (1 & 4)	45	25	8	12	182,518	1,008	1,204	1	1	2	9	13	33	10	23	303	369
Gulf Coast (2 & 3)	50	25	5	20	335,866	956	1,045	0	2	2	10	14	18	12	39	264	333
East (5 & 6)	19	12	0	7	99,837	474	436	0	0	0	5	5	4	0	2	139	145
N. Central (7-B & 9)	185	84	7	94	544,517	3,023	2,952	2	0	2	52	56	133	0	10	781	924
West (7-C & 8)	107	86	3	18	479,005	2,352	2,221	4	0	2	9	15	55	0	8	299	362
Panhandle (10)	20	16	2	2	76,982	514	464	0	0	0	2	2	4	4	1	26	35
Utah	2	2	0	0	11,332	68	36	0	0	0	0	0	5	0	3	32	40
West Virginia	14	2	8	4	37,438	233	254	0	0	0	1	1	0	0	7	4	11
Wyoming	18	5	2	11	80,005	302	284	1	0	0	8	9	12	0	3	91	106
Miscellaneous (S. D.)	1	0	0	1	8,861	27	56	0	0	0	1	1	0	0	1	21	22
Total United States	**984**	535	81	368	4,112,305	20,092	21,909	18	4	12	189	**223**	514	45	188	3,828	4,575
Total previous week	1,053	569	63	421	4,492,503	.....	.....	23	1	13	206	243	496	41	176	3,639	4,352
Total May 19, 1956	1,237	679	86	472	5,007,887	.....	.....	30	1	14	219	264	586	62	150	3,962	4,760
Cumulative, 1957	20,092	10,779	1,450	7,863	83,352,193	.....	.....	...	....	....	....	....	....	....	....	....	....
Western Canada	46	24	1	21	199,791	940	847	2	0	0	15	17	25	0	19	215	259

*Incl. N. Y. †Ala. Service wells included: ‡5, §1, ¶4.

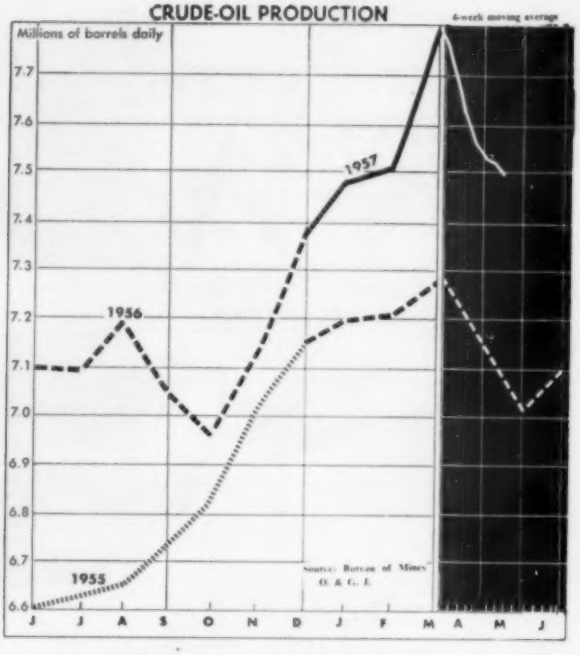
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

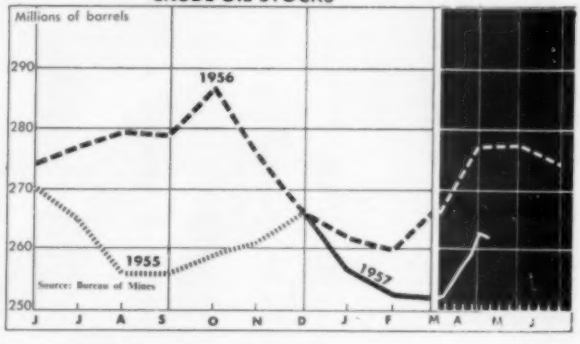


DAILY AVERAGE PRODUCTION FOR WEEK

	May 18, 1957			May 11
	Crude oil	Lease condensate	Total	total
Alabama	11,825		11,825	11,850
Arkansas	84,875	325	85,200	85,500
California	928,300		928,300	928,000
Colorado	157,500		157,500	158,200
Eastern	49,900		49,900	50,600
Florida	1,250		1,250	1,250
Illinois	225,400		225,400	231,600
Indiana	32,700		32,700	32,800
Kansas	†360,500		360,500	†337,800
Kentucky	47,700		47,700	47,300
Louisiana	853,100	73,100	926,200	926,200
North	130,600	3,100	133,700	133,700
South	722,500	70,000	792,500	792,500
Michigan	28,900		28,900	26,400
Mississippi	110,650	4,375	115,025	115,025
Montana	71,800		71,800	72,200
Nebraska	50,750		50,750	50,800
Nevada	100		100	100
New Mexico	264,650	4,600	269,250	269,250
North Dakota	29,400		29,400	31,700
Oklahoma	†636,400		636,400	†590,000
Texas	3,107,000	53,800	3,160,800	3,160,800
Dist. 1	57,000	450	57,450	57,450
Dist. 2	148,000	8,350	156,350	156,350
Dist. 3	440,000	26,300	466,300	466,300
Dist. 4	231,000	6,300	237,300	237,300
Dist. 5	40,000	400	40,400	40,400
Dist. 6	136,000	6,000	142,000	142,000
East Texas Field	205,000		205,000	205,000
Dist. 7-B	167,000	75	167,075	167,075
Dist. 7-C	170,000	3,800	173,800	173,800
Dist. 8	1,185,000	1,100	1,186,100	1,186,100
Dist. 9	218,000	700	218,700	218,700
Dist. 10	110,000	325	110,325	110,325
Utah	9,100		9,100	9,200
Wyoming	287,350		287,350	285,750
Others	‡100		100	‡100
Total U. S.	7,349,250	136,200	**7,485,450**	7,422,425
Change from previous week, up			**63,025**	
Canada	†560,600		†560,600	†469,500
Total U. S. production—January 1-May 18			1,049,199,275 bbl.	
Same period last year (crude plus cond.)			*999,354,130 bbl.	

*Includes 17,904,700 bbl. condensate. †Week ended previous Monday. ‡South Dakota.

CRUDE-OIL STOCKS



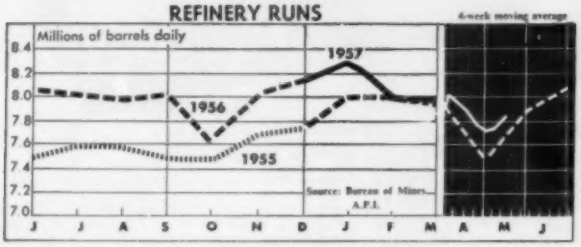
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

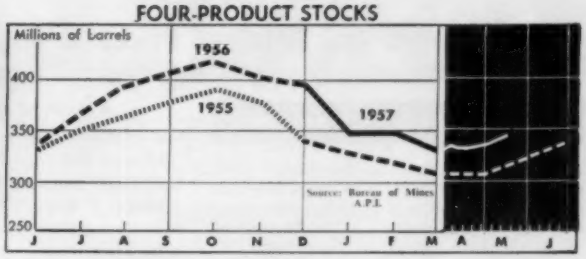
	5-11-57	5-4-57	5-12-56
Pennsylvania Grade	2,710	2,778	2,747
Other Appalachian	1,953	1,925	2,124
Illinois, Indiana, Michigan	9,524	9,585	10,012
Nebraska, North Dakota	1,702	1,427	2,320
Kansas	9,938	10,195	9,036
Oklahoma	22,854	22,192	26,734
Arkansas	2,728	2,860	3,058
Louisiana	18,187	18,621	16,784
North	2,998	2,982	2,646
South	15,189	15,639	14,138
Mississippi	2,620	2,431	2,956
New Mexico	7,315	7,282	7,507
Texas	119,775	120,516	125,814
East Texas proper	11,142	11,116	9,159
West Texas	57,035	56,647	62,101
Texas Gulf	22,120	22,422	22,906
Other Texas	29,478	30,331	31,648
Wyoming	16,267	16,428	16,857
Other Rocky Mountain	6,330	6,077	5,954
California	26,176	26,795	27,760
Foreign	†13,797	13,758	13,943
Total	261,876	262,870	273,606

*Bureau of Mines. †Includes 2,633,000 bbl. in California.

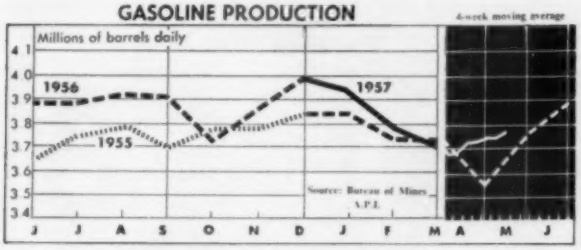
REFINERY RUNS



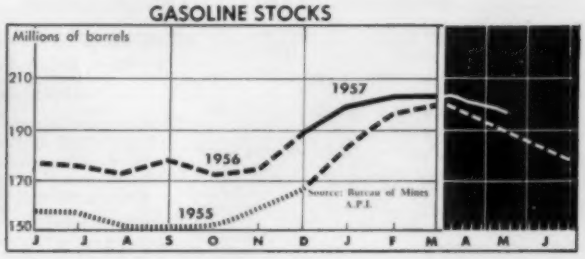
FOUR-PRODUCT STOCKS



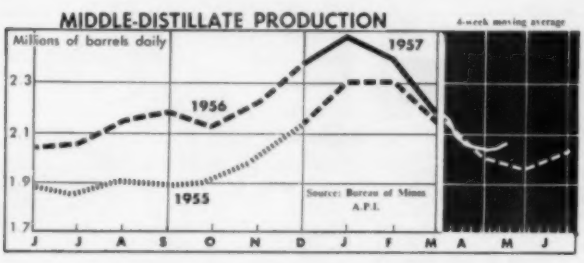
GASOLINE PRODUCTION



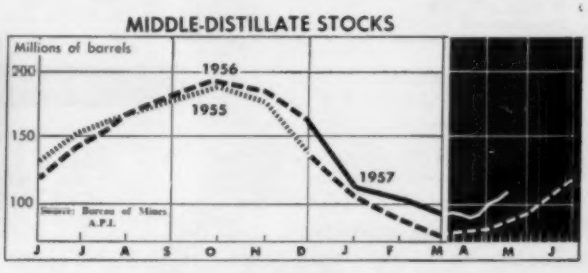
GASOLINE STOCKS



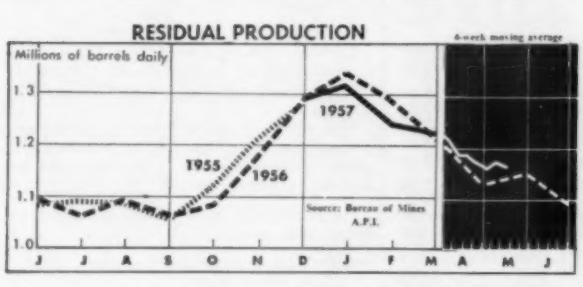
MIDDLE-DISTILLATE PRODUCTION



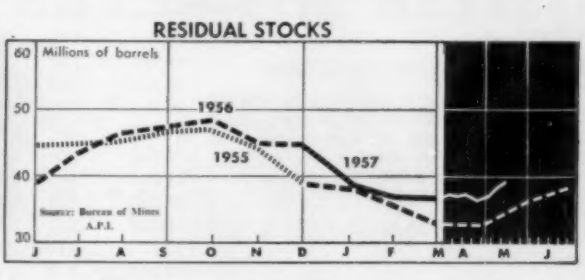
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, MAY 17, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, May 1956—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,277	501.2	42.4	364.9	215.0	43,127	9,805	28,528	10,134	1,043	417.0	27.6	239.6	196.5
Appalachian:														
District 1	86	32.9	3.0	17.4	4.7	4,704	488	1,978	488	93	35.5	3.7	22.4	4.0
District 2	92	51.7	4.3	15.3	11.0	2,628	408	671	339	106	49.7	4.0	17.2	15.0
Ind., Ill., Ky.	1,449	682.4	66.6	273.7	164.9	35,730	3,953	13,531	5,091	1,359	678.3	70.7	253.8	167.4
Minn., Wis., Dak	102	49.4	10.6	28.2	10.4	6,115	563	3,830	386	79	36.7	5.0	22.4	5.8
Okla., Kans., Mo.	710	384.6	15.8	171.4	17.9	18,802	1,158	8,008	896	704	377.9	18.9	151.1	30.1
Inland Texas	264	179.4	5.4	46.2	19.6	8,009	324	1,744	1,731	280	199.0	8.4	52.6	24.0
Texas Gulf Coast	1,849	914.0	63.3	486.0	226.3	26,387	2,773	9,508	4,802	2,019	939.9	98.1	480.4	262.3
La. Gulf Coast	672	361.3	48.4	188.7	48.6	10,911	2,158	4,647	1,314	710	362.9	38.5	169.9	52.0
N. La. and Ark.	79	29.7	2.9	20.1	5.1	4,418	697	1,581	76	97	30.1	5.3	24.2	6.1
Rocky Mountain:														
New Mexico	28	13.4	0.6	5.1	3.4	378	7	100	66	22	11.6	0.4	4.1	3.2
Other Rocky Mt.	241	131.0	1.0	56.6	32.7	7,628	229	2,466	1,126	270	121.5	3.8	63.4	32.7
California	1,282	534.3	3.0	184.0	354.4	27,546	291	10,238	12,977	1,114	496.0	7.8	165.5	349.6
May 17, 1957	8,131	3,865.3	267.9	1,857.6	1,114.0	196,383	22,854	86,830	39,426	7,896	3,756.1	292.2	1,666.6	1,148.7
May 10, 1957	8,050	3,717.0	297.1	1,824.6	1,195.7	197,402	21,907	82,260	38,745	.....	.....	.....	.....	.....
May 18, 1956	7,848	3,664.7	293.6	1,661.4	1,174.3	186,856	19,931	68,495	33,414	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (88 octane)	11.75-12.25
★ Premium (96-98 octane)	13.50-14.50
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.75-11.25
Regular (92 octane)	11.00-11.50
Premium (97 octane)	12.75-13.25
Premium (98 octane)	13.00-13.50
California (rack):	
Regular (86 octane)	13.1
Premium (93 octane)	15.3
Premium (96 octane)	16.2
Caribbean area (cargoes):	
Regular (97 octane)	10.875
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.0
Breckenridge:	
Grade 26-70	3.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	10.00-10.375
Diesel oil (58 d.i. and above)	9.625-9.875
Distillate No. 1	9.625-9.875
Distillate No. 2	9.00-9.375
Gulf Coast (cargoes):	
★ Kerosine 41-43	10.125-10.50
★ Distillate No. 2	9.625-10.00
New York Harbor (barges):	
Kerosine 41-43	11.75
Distillate No. 2	11.15
Diesel fuel, 48-52 d.i.	11.45
Caribbean area (cargoes):	
Distillate No. 2	9.75-10.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$2.25-2.35
Gulf Coast (cargoes):	
Bunker C fuel	$2.75-3.00
New York Harbor (barges):	
★ Bunker C fuel	$3.10
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.89
16-16.9	2.74	....	....	....	1.94
17-17.9	2.78	....	....	....	1.99
18-18.9	2.82	....	....	....	2.04
19-19.9	2.85	....	....	....	2.09
20-20.9	2.89	$2.75	....	$2.62	2.14
21-21.9	2.93	2.77	....	2.64	2.19
22-22.9	2.97	2.79	....	2.66	2.24
23-23.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low Cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, January 16, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.88
Middle District	4.70
Southwest Pennsylvania	4.41
West Virginia	4.23
Buckeye Grade	4.23
Zanesville Grade	3.27
Illinois Basin	**3.15**
Canada:	
Leduc-Woodbend	2.78
Redwater (Alta.)	2.67
Smiley (Sask.)	2.44
Pembina	2.65

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 40°-40.9°, Puerto La Cruz	3.37
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$1.97
Iranian, 34.0°-34.9°, Bandar Mashur	1.91
Iranian, 34.0°-34.9°, Abadan	1.86
Iraq, 36.0°-36.9°, Fao	1.87
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.72
Qatar, 39.0°-39.9°, Umm Said	2.06
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Iraq, 36.0°-36.9°, Tripoli, Banias	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°-38°	2.60

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

Gulf-U.S.N.H., clean (USMC—15%)	$2.42
★ N.W.I.-Montreal, dirty (USMC—40%)	2.43
★ N.W.I.-France, dirty (USMC—50%)	3.30
★ P.G.-Japan, dirty (USMC—35%)	5.85
★ P.G.-California, dirty (USMC—40%)	9.78

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LEASE AND DRILLING BLOCKS

440 ACRE LEASE, 10 wells pumping, 3 wells ready to Frac, offsetting water flood, plenty location to drill. Need capital. Price $75,000. Lease equipped with Jensen Jacks. A. R. Daniel, Garnett, Kansas.

WELL MADE 15 bbls. natural when plugged 1920s. Pawnee County, Oklahoma. Lease for owners ⅛ only. Martin, 1314 So. Willow, Ottawa, Kansas.

17,500 ACRES prospective gas and oil wildcat. Anticline established. Federal leases. Southern Utah, Wasatch Plateau. Ready market. Pipeline traverses block. Outright purchase, or drilling deal. Box K-196, The Oil and Gas Journal, Tulsa, Oklahoma.

4,000 PLUS ACRES fee leases covering closed visual structure North-Central Montana. 35 miles from prolific Bowes oil field. Been tied up for ten years. Drilling to about 3,200 ft. min. required. Trams Corporation. 345 Milton Ave., Salt Lake City, Utah. Phone INgersoll 7-6389.

FOR SALE AT INVENTORY: Oil property —Chautauqua County, Kansas. Suitable for water flood, with possibility of deep production, consisting of 430 acres in one block with 9 wells, power, tanks & lease house. $18,000. Four hundred acres in another block with 7 old producing wells. $12,000. Production from these wells dates back to 1918. Pipe line connections, land owner royalties only. 30 to 50 ft. sand. Contact Kenneth Johnson, at Johnson Supply Store, Osawatomie, Kansas.

640 ACRE producing lease, Strahn Pool, Nemaha County, Kansas. Will farmout lease and equipment. R. D. Swan, 818 Kennedy Building, Tulsa 3, Oklahoma.

CLIENT four hundred forty acres for drilling operations. Producing wells fourth year less than half mile either side. George Jacques, Uncas, Oklahoma.

OIL, GAS AND MINERAL LEASES available in Dell City area of Hudspeth County, Texas. U. S. Geological Survey Map shows anticlinal axis nearby favorable for oil-gas structure. Am fee landowner of over 2000 acres. Write quickly to: Jefferson G. Smith, 215 Littlefield Building, Austin 15, Texas.

OIL & GAS LEASE:

122 sections or 78,411 acre ranch. 10 year commercial lease, $1.00 per acre bonus, 50c per acre rentals. Lays about 60 miles west of Oldham County, Texas. One owner, one lease.

COMBEST ROYALTY COMPANY
Amarillo, Texas

OIL LEASES IN BOOMING

4-Corners Area. November Indian Lease sale brought 30 Million Dollars. Some leases sold for $3,200 per acre. Wells estimated up to 1500 barrels of oil per day. Oil Leases from $2.25 an acre. Fortunes being made. Write for free information now. **ATLAS OIL SURVEY, Dept. OJ-5, Colorado Bldg., Denver 2, Colo.**

FOR SALE EQUIPMENT

FOR SALE at our Okla. City warehouse—1 45 HP Happy No. One pumping unit, $2500.00. Also 1 Lufkin No. 56, size 6½ Ditto less beam, Sampson Post and Pitman $1000.00. See T. P. Mace at Whse. Cities Service Oil Company, Patridge, Bartlesville.

1 36L BUCYRUS Spudder complete with 5 and 7 inch tailing in tools. Dog house, butane tank, junk rack and light plant. Rod and tubing tools and hand tools. Phone Office 144, Res. 614, Cleveland, Oklahoma.

600 HP. RATHBUN-JONES Diesel Engine, with G.E. 250 KVA—200 KW—240 volt generator direct connected to line shaft; complete pneumatic starting equipment; fin-fan heat exchanger (16' x 11'—Fluor Corp. Los Angeles). Cooled by 10 ft. four bladed fan powered by 25 hp. motor. Closed cooling system eliminates scale problem. Six-cylinder, 16-in. bore, 24-in. stroke engine designed to operate 215-265 r.p.m. easily converted to natural gas operation. All new cylinder liners, pistons, bearings, and bushings. $12,500 f.o.b. The New Era Milling Company, Arkansas City, Kansas.

FOR SALE EQUIPMENT

32 DRILL COLLARS, 20 ft. OD, 5", ID 3 in., 41-40 heat-treated steel, BRAND NEW. $300 each. Ask for Ralph Varel. FL 1-6487, Varel Mfg. Co., 9230 Denton Dr., Dallas.

COMPLETE PIPE-THREADING shop. Two Landis machines 13⅜" and 7", with building, fully equipped. Bargain. Phone DIamond 3-9563. Lundquist, Box 1215, Tulsa, Oklahoma.

FOR SALE—Cardwell Spudder, RL502, complete with tools, equipment necessary for efficient operation. Price, inventory on request. K & A Drilling Co., Phone 448R, Box 497, Ellinwood, Kansas.

8000 FT. DRILLING RIG For Sale. Complete rotary rig in A-1 condition; consists of Wilson "Roadair" Giant Drawworks with oil bath compound for two engines, 2-LRO Waukesha Engines, 14PHD Oilwell Pump, 4½" API Full Hole drill pipe, standard 128 ft. derrick and substructure, and all other necessary equipment. Inventory and other information furnished on request. Write to Box 966 or Call PLaza 3-5724, Longview, Texas.

BRILL BUYS—THE BEST!

NEAR LONGVIEW, TEXAS

FORMER LACY REFINERY

1—Wyatt 30" x 70' Stabilizer 160# 36 tray
1—8' x 96' tower, 40 tray, 135# WP.
1—2' x 50' tower, 24 trays.
1—Ethyl lead plant.
2—Upshot heaters, 10 mil. BTU/hr.
8—Welded storage tanks, 5,000, 2,000 bbl.
8—Hi-vol pumps, 10 x 7 x 18, 10 x 8 x 12, 6 x 4 x 12, 6 x 3 x 8.

IN STOCK

VESSELS

2—12' x 45' Storage Tanks, 25#
1—14' x 21' Clay Tower, 125#
1—8' x 73' Tower, 20 Trays, 25#
1—18" x 32' Tower, 15 Trays, 160#
2—8½' x 29' Tanks 80#
5—Packed Towers 14" x 40', 18" x 23', 160# Wyatt 1950.
1—Poly Reactor, 550#, 24" x 28'.

HOT-OIL PUMPS

3 Pacific ITB, 400 gpm—2,000' hd, 735 gpm—3,100' hd.
5 Pacific 5VTB, 612 gpm—600' hd, 324 gpm—480' hd, 308 gpm—516' hd, 193 gpm—389' hd.
1 Pacific HVTB (unused) 1270 GPM—408' Hd.
8J hot oil pump 3 x 9, 13 st, 325 gpm, 4600' hd.

HEAT EXCHANGERS

4—Kellogg Adm. Ftg. Hd. 2200, 1300 Sq. Ft., 315#
4—Kellogg Steel Ftg. Hed. 800, 650, 500 Sq. Ft.
18—GR Fin Tubes, 73 Sq. Ft.
6—Brown fintube exchangers, 300# 140 Sq. Ft. 4-6 chrome.
5—Steel 1,000, 900, 800, 600, 500 Sq Ft.
6—Adm. 785, 742, 425 Sq. Ft.
30—304 SS shell & tube condensers 100-1000 Sq. Ft.

COMPRESSORS

1 Worth LTC-6 800 hp.
3 Penn Comps 100 CFM 500 lbs.
385 CFM 160 lbs.

MISCELLANEOUS

6—Bird Centrifugals 32 x 50, 24 x 36, 18 x 28.
5—Sweetland Filters No. 12, No. 10, No. 7, No. 5.
4—Rotary Vac. Filters, 10 x 12, 8 x 10, 5 x 8.
2—Lab Petro-Chem Furnaces ½, ¾ Mil BTU/hr.
Tremendous selection stainless steel and steel valves 1½"-8".
Goulds 16" pump, 10,500 gpm, 135' hd.

PARTIAL LIST ONLY

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BRILL EQUIPMENT COMPANY

4101 San Jacinto St., Houston 4, Texas, JA 6-1351
OR
2401 Third Ave., New York 51, N. Y., CYpress 2-5703

FOR SALE EQUIPMENT

FOR SALE at our Wichita gasoline plant—14 30" OD x 40' shell 3 section riveted absorbers. ⅛" shell, ⅝" heads filled with 3" triple spiral tile. 145# PSI, 400# Hyd. test pressure. Recently replaced in remodeling our plant. Each $350.00 Cities Service Oil Company, Patridge, Bartlesville.

LIMITED AMOUNT of ⅝ and ¾ used sucker rods 10c & 12c. Daniel Pipe and Supply, Garnett, Kansas.

FOR SALE—One UH-54A Emsco Drawworks Steam Drilling Rig complete with four 125 HP 250# WP Boilers, with Derrick, less drill pipe. Inventory on request. Currently drilling Elmore City, Oklahoma. Contact Sohio Petroleum Company, J. R. Wilson, Jr., Purchasing Agent, 1265 Skirvin Tower Hotel, Oklahoma City, Oklahoma, Telephone REgent 9-0512, Extension 284.

FOR SALE EQUIPMENT

FOR SALE: 2—36L Bucyrus Erie Spudders with or without tools. All in excellent condition. Write Box 190 or call BRoadway 3-7501, Borger, Texas.

BESSEMER GAS COMPRESSORS—3 type 10 twins direct connected units—Boswell-Frates Company, 1003 Kennedy Building, Tulsa, Oklahoma.

GAS COMPRESSOR

800 H.P. Worthington. May be seen in operation. Like new. Too large for present job. Owner will sacrifice. Call:

CARSON MACHINE & SUPPLY CO.

ME 8-1511—Oklahoma City
Tulsa, Great Bend, Garden City

FOR SALE EQUIPMENT

USED LATE MODEL 71 and 72 Speedstars, 24L and 28L Bucyrus, all complete with tools. Star Drilling Supply Co., Manufacturers of Rotary and Cable Tools, Chanute, Kansas.

FAILING HEAVY DUTY 1500, long mast, kelly, 1952 L-182 truck, 1200' drill pipe. Others. Fred Butler, Box 481, Pueblo, Colo.

FAILING DRILLING RIGS. One 1500 and one 1500 heavy duty complete ready for operation. Ted Wells, 6427 East Kellogg, Wichita, Kansas.

C-34 WALKER-NEER Spudder, with or without 5-7 tools. A-1 condition. Fully equipped. Located at Drumright, Oklahoma. Box 788 or phone 20, Drumright.

LIQUIDATION—Drumright, Okla.

TIDEWATER OIL COMPANY

Modern 15,000 Bbl./Day Refinery

Presently being dismantled — Immediate removal and shipment — exceptional prices

HOUDRIFLOW CATALYTIC CRACKING UNIT, 8800 BBL./DAY (NEW 1952)

TOWERS

8'x5'x85'6" 25 Trays 250 PSI
8'x34'6"x½" 10 Trays
6'x30'x½" 9 Trays
4'6"x30'5"x⅜" 14 Trays
4'x49'6"x⅞" 24 Trays 330 PSI
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3'x23'6"x1⅛" Catalyst 600 PSI (2)

ETHYL BLENDING PLANT 8500 GAL. COMPLETE SKIMMING POND

VESSELS

6'x40' SOAKER, 500 PSI @ 850° F.
20'x28'4" AGITATOR, cone bottom
10,000 bbl. HORTONSPHERE
6500 gal. PROPANE TANK

50,000#/HR. COCHRANE WATER TREATING AND DEAERATING PLANT

HEAT EXCHANGERS

Sq. Ft.	Type	Tubes	Shell
1080	Reflux	Adm. 125#	Steel 250
993	Reboiler	Steel 600#	" 600
970	"	" 125#	" 250
750	"	" —	—
331	16-138	Adm. 250#	Steel 250
331	16-138	Adm. 125#	" 250
Brown	Fintube	Steel 600#	(11)

110,000 GAL. FOAMITE SYSTEM—COMPLETE

VACUUM CRUDE DISTILLATION UNIT, 15,000 BBL./DAY (NEW 1953)

FURNACE TUBES

500—New Crolay #5, 3" to 6⅝" OD 15' to 32' long
500—4", 4-6% Chrome, headers
200—4½", 4-6% Chrome, headers
200—5", 4-6% Chrome, headers

UPSHOT HEATER COIL TYPE "D" 3" PIPE 600 PSI—417 SQ. FT. GAS FIRED

PUMPS

HOT OIL 334 GPM, 1,000 PSI (2)
FIRE 2500 GPM at 426' head
CENTRIFUGAL from 60 to 1500 gal. from 40' to 655' head
STEAM—Hot Oil—Simplex—Duplex
PROPORTIONING—1 to 5 HP

2-28 SPOT CAR LOADING RACKS, CAPABLE 10 PRODUCTS EACH SPOT

OTHER ITEMS

1000 M CFD COOPER GAS COMPRESSOR
HEAT EXCHANGERS—196-3100 sq. ft. (25)
NEW STEEL STACKS—240'
53—STORAGE TANKS—1,000-100,000 bbl.
40—STORAGE TANKS—1,000-27,000 gal.
10 Ton OVERHEAD TRAVELING CRANE
PIPE—VALVES & FITTINGS—
MACHINE TOOLS—WELDERS—
HYDRAULIC JACKS—HAND TOOLS—
CHEMICALS, ETC.

TELEMATIC 48 TANK GAUGING SYSTEM

Your inspection invited—representatives on premises
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TULSA OFFICE—310 Thompson Bldg., Tulsa 3, Okla., Diamond 3-4890
DRUMRIGHT OFFICE—P. O. Box 587, Drumright, Okla., Phone 569

FOR SALE

A clean D7 Caterpillar tractor, series 4T with an inside hydraulic 8' blade and a D7N Hyster worm driven winch. Serial #19131.

For further information concerning this equipment call

HENSON DRILLING COMPANY

OR 2-4112, or write to Box 2192, ABILENE, TEXAS

FOR SALE

Quality Pipe and Plate

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PIPE—A-53 AND A-106
Seamless—Sizes 2" thru 24"
Schedules 40 thru 140
A-285-C F.B. Plate in Long Lengths
Thickness ¾" thru 1¼"

Above available in large quantities as plate or fabricated to your specifications.

CONTACT—

FLUOR PRODUCTS COMPANY

PAOLA, KANSAS PHONE: 320
Attn.: MR. FRANK PETERSCHMIDT

FOR SALE

5—Gardner-Denver Model PL-7A, 4¾ x 3½ x 7 triplex pumps. Complete with Twin Disc Converter. Operating condition, recently retired from cementing service. Priced to sell.

2—Patso Wire Line Trucks. International Chassis KB7, 1949, 1950. Complete operating units with 15,000 ft. ⅜ line hoist and controls, 110v, A.C. generating plant. Bodies and engines in good condition. Priced to sell.

CONTACT:

BJ Service, Inc.

6505 PARAMOUNT BLVD.
LONG BEACH 5, CALIFORNIA
Telephone: NEvada 6-0201
W. T. BOX or M. B. RIORDAN

FOR SALE EQUIPMENT

LIQUIDATION 11,000 BBL. REFINERY

D-X SUNRAY OIL CO., ALLEN, OKLA.

We are now liquidating this modern refinery and can offer equipment at a fraction of its cost.

INCLUDED ARE: 6 Heaters with Chrome Tubes, Welded Towers from 2' to 8' with Operating Pressures up to 475 psi., Reboilers, Accumulators, Heat Exchangers, Hot Oil Pumps, Centrifugal and Steam Pumps, Boilers, Gas and Diesel Generator Sets, New Chrome Heater Tubes, Pipe, Valves, etc.

Your Inspection Is Invited. Write for Catalogue.

HEAT & POWER CO. Inc., 60 E. 42 St., New York 17, N. Y. 310 Thompson Bldg., Tulsa 3, Okla.

USED MODEL 300 JOY DRILLING RIG

Capable of Drilling to a Depth of 3000 ft. with 3½" drill pipe

Complete as follows:

1 Joy Model 300 Rig with main drum, sand reel, 12½" rotary table, 1 standard cathead, 81 ft. mast, 2—140 GKU Waukesha engines with combination gasoline/butane carburetors.

2 Torcon torque converters
1 Surge Chamber in derrick
2 Tong Lines & Counterweights
1 Drill Deck & Substructure
1 Set of Walkways
1 Semi-Automatic Cathead
1 Rathole Attachment
1 Kelly Driver for 3½" sq. kelly
1 Drilling line, ⅞" x 750' lg.
1 Triple Sheave Block (65 ton)
1 Water Swivel (King 75-WP) with 2⅞" elevator space & 4½" API Reg. Pin conn.
1 Swivel Hose, 3" x 35' lg.
1 Sub, swivel to kelly
1 Kelly, 3½" sq. x 36' lg.
1 Spinning Cylinder Assembly

1 Trailer, 40,000 lb. capacity w/eight 10:00x20 tires, inverted 5th wheel, stop light, and air brakes.

This rig has been thoroughly tested by our service department and will be sold with a new rig guarantee, which includes the service of a Joy Serviceman.

For additional information write to:

JOY MANUFACTURING COMPANY

OIL FIELD DRILL DIVISION

6540 Harry Hines Blvd. **P. O. Box 35326 Airlawn Station**

DALLAS 35, TEXAS

FOR SALE: Late Model Cardwell Double Drum Spudders. Ser. #RL-666 and RL-701, complete with large inventory of tools and equipment (extra good). General Tool & Supply Co., Box 4387, Oklahoma City, Okla.

SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment; from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply Co., Tulsa.

BUSINESS OPPORTUNITIES

FINANCIAL CONTACTS. Underwriters. Brokers. Private Finders of Capital reached. No shopping. Confidential. FREE ENTERPRISE ASSOCIATES, 817 51st St., Brooklyn, N. Y.

EQUIPMENT WANTED

WANTED—Air-Cooled Gas-Coolers. Sizes: 0-100#. 1-4 million. 100-400#. 1-4 million capacity. Clay Johnson, Phone 6539, Vivian Louisiana.

EQUIPMENT WANTED

EQUIPMENT WANTED

2—14" Bore x 12" Stroke Compressor cylinders complete with pistons and rods, maximum working pressure 150#, for Ingersoll-Rand SVG-10 Compressor.

Champlin Oil & Refining Co.

P. O. Box 915
Oklahoma City, Oklahoma
Telephone VIctor 3-1513

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DESIGNED FOR YOU!—Over 400 styles, sizes and kinds from which to choose. Sheets with 1 to 30 columns. Also horizontally-ruled sheets with no columns. Choice of Kraftbilt Green-Tint, Ivory, Canary or White Paper. Variety of sizes from 8½ x 11 to 14 x 25½ inches. Screened lines guide you without dominating entries. Ask for Catalog 57-P, Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Okla.

HELP WANTED

RESERVOIR ENGINEER—permanent position with independent oil company for evaluation work, appraising oil and gas properties in various parts of U.S.A. and Canada. Headquarters Denver. Age limitation 28-35. Splendid opportunity for one with sufficient experience in valuation work, field analysis, well completions, property maintenance. Complete resume, photograph, professional engineer's registration number, or be qualified for registration. College transcript, 5 character and 5 professional references and salary expectation must be furnished prior to interview. 321 U. S. Nat'l Bank Building, Mile High Center, Denver, Colorado.

Pipe Line Engineer

Opening for graduate engineer. Experienced in oil pipe line, Pump Station & Terminal design.

WRITE or CALL

PIPE LINE ENGINEERING COMPANY

P. O. BOX 13227
DALLAS 20, TEXAS
Phone: FLeelwood 7-1789

Experienced Asphalt Sales Engineer

Must be thoroughly familiar with pricing and specifications and have wide acquaintance. To be located in Mid-Continent area. Good opportunity for right man. State age, experience and starting salary expected. All replies will be kept strictly confidential.

Box K-129,
The Oil and Gas Journal,
Tulsa, Oklahoma.

Automotive or Chemical Engineer

Position open for graduate automotive or chemical engineer with knowledge of gasoline behavior research. The work is varied in nature and requires capable man to coordinate research, author technical publications and maintain contacts within the industry. Position offers immediate responsibility in a growing technical service activity. Location in a Detroit suburb offers ideal professional environment with a choice of city or suburban living. For more particulars send name and address to:

PERSONNEL MANAGER

ETHYL CORPORATION

1600 W. 8 MILE ROAD
FERNDALE 20, MICHIGAN

HELP WANTED

ENGINEERS WANTED: By crude oil pipe line operating company for general engineering. Applicants not over 30 years of age and must have a recognized degree in engineering from an accredited engineering school. Experience not essential. Salary based on experience and qualifications. When making application, please furnish resume of experience record, personal data, and copy of college transcript. Reply to EMPLOYEE RELATIONS DEPARTMENT, Interstate Oil Pipe Line Company, P. O. Box 1107, Shreveport, Louisiana.

WANTED!

OIL FIELD DEVELOPMENT FOREMAN

Experienced drilling man. Able to run casing and perform all phases of oil or gas well completion work. Act as Company representative on contract rig. Offshore and onshore work. Attractive starting salary.

DRILLING ENGINEER

Man capable of performing same work as Development Foreman—but with Engineering training and/or degree. Salary commensurate with qualifications of applicant.

APPLY:

OCEAN DRILLING & EXPLORATION CO.

918 Carondelet Bldg.

Phone TU 2143, Ext. 23 or 21

New Orleans 12, La.

HELP WANTED

WANTED: Graduate petroleum engineers with 4 to 6 years production and drilling experience for employment in the Louisiana Gulf Coast area with large independent, integrated oil company. Mr. E. E. Sands, 800 Prudential Building, Houston 25, Texas.

TOOL PUSHERS

Major drilling company has opening for experienced tool pushers in West Texas and New Mexico. Must be familiar with all kinds of equipment and have drilling experience on medium and deep holes. Must be sober, dependable, and under 40. Give complete details of experience, past employment, and personal references in letter.

Box K-198,

The Oil and Gas Journal,

Tulsa, Oklahoma.

Petroleum Refinery Chemical Engineers

Positions involving technical service and consulting type work for petroleum refineries are available in refinery technology division. Chemical engineers working in refinery process engineering or operation and economic analysis are well qualified for these positions. Positions offer a wide variety of work assignments in an expanding technical activity that works with sales, research, refinery, and company management problems. Positions also afford opportunities for industry-wide contacts with refining and process companies and for using initiative and individual expression to increase responsibility. Location in a Detroit suburb offers ideal professional environment with a choice of city or suburban living. For more particulars send name and address to:

PERSONNEL MANAGER

ETHYL CORPORATION

1600 W. EIGHT MILE ROAD

FERNDALE 20, MICHIGAN

HELP WANTED

ESTABLISHED INDEPENDENT oil company has immediate opening for graduate engineer with one or two years of experience in oil producing operations, to be located in Midland, Texas. Write giving full particulars regarding personal history and work experience. Box K-191, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED

Associate and Assistant Professors of Petroleum Engineering

If you have a Ph.D., some experience, and want to teach a select group of students in a leading western institution with facilities for research, and are young, able, and personable, communicate with the Dean of the School of Mineral Sciences, Stanford University, Stanford, California.

EUROPEAN OPPORTUNITY

Project manager required for European office of international consulting firm supervising technical aspects of construction and early operations of entirely new refinery. At least one year's service with good possibility of remaining in refinery operations. Require mature graduate engineer with refinery experience and good general knowledge of oil business. Excellent location in one of Europe's most attractive cities. Family transportation and living allowance included above excellent salary. Send resume to:

Box K-168,

The Oil and Gas Journal,

Tulsa, Oklahoma.

GAS PROCESS ENGINEER

Large independent oil company has opening for graduate engineer with minimum ten years' experience in design and operation of gas processing plants. Man selected will be located in main office and will be in charge of process control of several plants located in Texas and Louisiana. Age to 40. Attractive salary, liberal retirement and benefit plans. Replies will be treated confidentially. Mail complete relevant information to

BOX K-175, THE OIL AND GAS JOURNAL,

TULSA, OKLAHOMA.

GULF OIL CORPORATION

— ENGINEERS —

PETROLEUM
GAS
DRILLING
RESERVOIR
MECHANICAL
PIPE LINE

Subsidiary operating in Venezuela has opportunities for engineers with/without experience. Salary commensurate with experience.

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• Career employment with Major American Oil Companies • Salaries Open • Cost of Living Allowance • Monthly Bonus.

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Maximum Age to 40

- ENGINEERS, ALL TYPES—Degree required. Exp. or inexperienced.
- GEOLOGIST, Deg.—Age to 32. Single.
- TOOLPUSHERS, 3 to 5 yrs. experience.
- MECHANIC GAS, 5 yrs. experience.
- MECHANIC DIESEL, 4 yrs. experience.
- FOREMAN CONNECTION, 3 yrs. experience.
- FOREMAN ELECTRICAL, 3 yrs. experience.
- SUPERVISOR, OIL HANDLING, 3 yrs. Must have field experience.
- MUD TECHNICIAN, 1 yr. experience. Age to 32.
- TEACHER-PRINCIPAL, Male. Must have B.S. in education.
- TEACHER-STAFF CAMP, Male or Female, Jr. H.S. English
- TEACHER-STAFF CAMP, Female. Age to 35. Single. 3 years experience, 1st, 2nd, 3rd grades.
- STENOGRAPHER, Male or Female. 1 year exp. Age to 32. Must be single.

All information confidential.

Send complete resume to:

OVERSEAS EMPLOYMENT SECTION

CHAS. J. LOVELESS PERSONNEL SERVICE

616 S. Main • Tulsa, Okla. • GI 7-3193

HELP WANTED

CHEMICAL ENGINEER. Independent Oil Company needs Chemical Engineer under 35 with general knowledge of, and experience in construction, operation, and maintenance of gasoline plants, gathering systems, compressor stations, gas pipe lines, and related facilities, for permanent position in Louisiana. Knowledge of process engineering also helpful. Furnish information as to education, family status, work history, and salary requirements to P. O. Box 2162, Dallas 21, Texas.

SENIOR ACCOUNTANT. Experience required in the field of property unitization with a natural gas transmission firm, preferably one using IBM systems of property accounting. Must be capable of organizing and directing the efforts of others in establishing this new function of the property accounting section of a major natural gas transmission company. Will be required to relocate in Pacific Northwest area. Write Box K-189, The Oil and Gas Journal, Tulsa, Oklahoma.

IRAQ

Jobs in Iraq, new refinery, family accompanies. Excellent salaries and benefits, three year renewable contract. Age open. Must be U. S. citizen with refinery operating experience. Degree required.

NO U. S. INCOME TAX
OUR FEE PAID

ASST. CHIEF COORDINATOR, lube and asphalt. Minimum 7 yrs. experience, including supervisory. Ch.E. Degree.

ENGINEERING OPENINGS for civil, electrical, project, mechanical, chemical engineers, minimum 3 yrs. experience.

All inquiries confidential. Send resumes of experience to:

CHAS. J. LOVELESS
PERSONNEL SERVICE
816 S. Main • Tulsa, Okla. • GI 7-3193

PETROLEUM ENGINEER

Graduate engineer with experience in oil producing operations including pressure maintenance, secondary recovery, primary and depletion. Initial assignment in New York office in reservoir engineering and research section concerned with oil field development studies. Salary and position commensurate with qualifications.

Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 217

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

HELP WANTED

CHEMICAL ENGINEERS WANTED—By a medium sized petroleum refinery located in the Northwest. Two to five years' experience in economic forecasts and process analysis with a degree in Chemical Engineering from an accredited engineering school preferred. Salary based on experience, education, and qualifications. Liberal benefit and retirement plans. When making application please furnish a resume of experience, personal data, activities, and a copy of college transcript. Replies will remain confidential. Box K-190, The Oil and Gas Journal, Tulsa, Oklahoma.

TOP ASSIGNMENTS

FOR

PIPELINE ENGINEERS

Engineers that have recent qualifying experience in economic studies or design for construction of oil or gas transmission lines will be given immediate confidential consideration.

WRITE TO DON PALMER

BECHTEL CORPORATION

220 BUSH ST.,
SAN FRANCISCO 4, CALIF.

Recruiting offices also located in: New York, Los Angeles, and Houston.

GAS ENGINEER

For Caracas, Venezuela

CHEMICAL ENGINEERING DEGREE.
MINIMUM 5 YEARS EXPERIENCE

including compressor plant operations, design and operating gasoline plants and gas pipeline work. Capable setting up department when required and working with government representatives.

GOOD SALARY, ALLOWANCES,
OPPORTUNITY OBTAIN ADDITIONAL
EXPERIENCE AND ADVANCEMENT.

Send complete details to:

C. L. LAUE

SOCONY MOBIL OIL CO., INC.
NEW YORK 4, NEW YORK

SOCONY MOBIL OIL COMPANY, INC.

Has Opening for Chemical or Mechanical Engineer in Technical Service Laboratory

Excellent opportunity Investigating Domestic Burner Equipment and Fuels. Studies concerned primarily with Mechanical Factors Influencing Burner Operation.

Ideal candidate would be Engineer, with Bachelors Degree or better, having fundamental knowledge of combustion principles and practical experience in design and operation of oil burning equipment. Send Resume to:

SOCONY MOBIL OIL COMPANY, INC.
TECHNICAL SERVICE LABORATORY
412 Greenpoint Avenue
BROOKLYN 22, NEW YORK

HELP WANTED

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs. $5.00 cash. OIML Co., Box 2003, Tulsa, Okla.

CHEMICAL ENGINEER

Chemical Engineer with distillation experience for research and development at midwestern laboratories of nationally known food company. Prefer applicant having up to 8 years experience, including a good background in pilot plant development in the field of distillation. Work involves initial investigation of a distillation problem and carries through to the ultimate design and start-up of a new process or equipment. Submit complete resume including education, work experience, and salary desired.

Box K-180,
The Oil and Gas Journal,
Tulsa, Oklahoma.

SITUATIONS WANTED

LATIN AMERICA—geological engineer, twenty years experience foreign operational problems in addition domestic available independent entering foreign field. Box K-173, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING SUPERINTENDENT with administrative experience. Employed 20 years in Mexico and South America. Capable of assuming entire responsibility of drilling operations. Desires foreign employment. Box K-106, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: Four years exploration geology & reservoir studies. Desires position as production (exploration) geologist with a producing company. Currently employed with oil company. Single. Box K-176, The Oil and Gas Journal, Tulsa, Oklahoma.

CABLE TOOL DRILLER can't stand retirement. Age 63, active, sober, and in good health. Available to go anywhere, but prefer Mid-Continent or Southwest. Over 40 years experience in Kentucky, Oklahoma, Texas, Kansas, Pennsylvania, Ohio and West Virginia on all types of cable tool operations. Box K-192, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST: Age 53. Over 25 years varied experience in surface, subsurface geology and surveying in United States, Latin America and Europe with majors and independent practice. Fluent Spanish. Desires employment with company operating in Latin America having program for instruction of national trainees and translation of their reports. Available Sept. Box K-193, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM REFINING ENGINEER, five years experience including economic studies, design, construction and operation of natural gas gathering systems and field compressors, presently in charge of operations in large gasoline plant. Desires supervisory operating position in petrochemical plant or refinery with opportunities for advancement. Box K-194, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER, Age 36, 11 years varied experience in drilling, exploration, production, valuation and supervision both major and independent oil companies. Desire responsible position handling valuations with financial institution. Box K-195, The Oil and Gas Journal, Tulsa, Oklahoma.

INDEPENDENT OIL OPERATOR desires position with opportunity in substantial company. Experience in all phases of oil business, including promotion, drilling, production and accounting. Box K-186, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST—Exploration Manager, M.S. 10 years experience in all phases of Petroleum Exploration including Geophysical and Geological, administrative, land and leasing. Both major company and independent experience in North Texas, West Texas, and New Mexico, with good discovery record. Capable of initiating and administering complete exploration program. Now employed as exploration manager for independent concern, but willing to consider any desirable position with an aggressive company wishing to specialize in exploration in these areas. Box K-188, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

GEOLOGIST—10 years chiefly on Louisiana and Texas Gulf Coast with major, M.S. degree, young, family man, been district geologist several years with large staff, extensive background in Gulf Coast exploration, development, and drilling deal evaluation, can handle engineering aspects of development, desire permanent location in Houston with aggressive independent, lease and drilling group, or small company, might consider Lafayette or New Orleans, widely known and in good standing with excellent references. Box K-197, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: Ten years experience in drilling, completions, property evaluations, reservoir analysis, and secondary recovery operations. Experienced in Rocky Mountains, West Texas and New Mexico. Age 38. Desires affiliation with aggressive organization. Box K-187, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION FOR SALE

I HAVE FOR SALE 500 bbls. oil per day loaded in your cars or mine in Wyoming. Operator, Box 2153, Denver, Colorado.

REAL ESTATE

ANOTHER LARGE AUCTION

GOVERNMENT SURPLUS PROPERTY

PAMPA AUXILIARY FIELD #1— PAMPA, TEXAS

Tuesday, June 11, 1957 2:00 P.M. (C.S.T.)

Sale will be conducted in the show arena of the Top-O-Texas rodeo grounds in Pampa, Texas.

We have been authorized by the General Services Administration to offer at public auction, Government owned surplus property described as follows:

LOCATION AND DESCRIPTION: The property offered for sale hereunder consists of four sections of land including 8/8 mineral estate totaling approximately 2,544.71 acres and water, gas and cast iron sewer pressure lines for removal from the site. The property is a former airfield located twelve miles east of Pampa, Texas. The land will be sold in eight tracts; one of 640 acres, three of 320 acres and four ranging from 160 to 312.71 acres. Approximate quantities of utility lines and valves to be sold as one item for removal from the site are as follows: 48,905 ft. of water line and 85 valves size 4" to 10", 20,630 ft. of gas line and 23 valves size 3" to 6" and 6,770 ft. of 10 inch cast iron sewer pressure main.

INSPECTION: The property offered hereby is subject to inspection by prospective purchasers during the period May 10, 1957 through June 10, 1957. Prospective purchasers will be admitted to the site for inspection purposes between the hours of 9:00 A.M. and 4:00 P.M. Monday through Friday, exclusive of holidays.

The failure of any bidder to inspect or to be fully informed as to the condition of all or any portion of the premises or property offered, will not constitute grounds for any claim or demand or adjustment or withdrawal of a bid.

TERMS: Bids to purchase may be for cash or credit per regulations established by General Services Administration. All sales subject to confirmation of General Services Administration.

Contact auctioneers for further information. **Do not contact General Services Administration.**

A brochure containing a map of the tracts to be offered, with legal description, is available from the auctioneers.

Also maps locating the utility lines may be obtained by contacting auctioneers.

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OIL PRODUCTION WANTED. Producing primary and potential secondary oil and gas production . . . any size, any amount. Send full particulars to: Box K-178, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED FOR CASH—Depleted and Marginal Wells for Salvage. Frank J. Black, P. O. Box 150, Phone 107, McPherson, Kansas.

WANT TO BUY—Oil Properties, settled or semi-settled production. 100 to 5,000 barrels daily in Oklahoma and Kansas. Contact Morris Sitrin, 1215 First National Building, Tulsa, Oklahoma.

PRODUCING oil, gas properties, also royalties wanted. Any size, any amount. Complete details in first letter. Box 221, Scarsdale, N. Y.

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Mail: Apartado 3963
N. VanMiddlesworth
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Pipeline Patrol

(Continued from page 283)

• **Sinclair Oil Corp. and Socony Mobil Oil Co.**

Project: 211 miles of 20-in. from the Silvestre field in Barinas, Venezuela, to Puerto Cabello on Caribbean Sea.

Status: Under way.

Contractor: **Williams Brothers Sudamericano, Ltd.**

Completion: July 1957.

• **Standard-Vacuum Petroleum Maatschappij.**

Project: 94 miles of 8-in. from Lirik field, Central Sumatra, to deep-water terminal on Siak River, near Buatan. A 3-in. hot-water "defroster" line will be laid under the 8-in. to heat the heavy crude.

Status: Under way.

Completion: Late 1957.

• **Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie**

Project: Line in Sahara Desert area to move oil from Hassi Massaoud field. Two routes possible: 200 miles from the field northwest to Laghouat; 260 miles from the field to the north and slightly east to Biskra.

Status: Under study.

• **Union of Soviet Socialist Republic**

Project: 2,300-mile Trans-Siberian crude and products line from Ufa and the Tuimaza fields in Bashkiria to Irkutsk near Lake Baikal.

Status: Under way.

• **Yacimientos Petroliferos Fiscales** (Argentina)

Project: 932 miles of 12-in. from Campo Duran to San Lorenzo.

Status: Under way.

Contractor: **TECHINT** (Compania Tecnica Internacional), Buenos Aires, has 90 miles.

Foreign Products Pipelines

• **Empresa Nacional de Petroleos** (Government of Chile) and **Cia. de Petroleos de Chile (Copec), et al.**

Project: 75 miles of 10-in. from Chile's coastal refinery at Concon to Santiago.

Status: Planned.

Contractor: **Williams Brothers** has design and engineering contract.

Completion: Design plans will be completed August 1, 1957. No date for construction has been set.

• **Israeli Government**

Project: A 6-in. line from the Haifa refinery to Tel Aviv.

Completion: Late 1957.

• **North Atlantic Treaty Organization (NATO)**

Project: 2,000 miles of lines to airfields in parts of Europe.

Status: Under way.

Contractors: **Associated Pipeline Contractors, Inc.,** has 450 miles from Iskenderun, Turkey, to Batman. **TECHINT** (Compagnia Tecnica Internazionale), Milano, Italy, has 205 miles of 4-in. from Bandirma to Eskisehir, Turkey, and 250 miles of 8-in. from Antalya to Eskisehir. Bids were taken in January 1956 on 300 miles of 12-in. between Marseille and Langres, France. Taking bids on 275 miles in northwestern France: 54 miles of 2-in. from Langres to Mirecourt, 63 miles of 2-in. from Mirecourt to Phalsbourg, 47 miles of 8-in. from Mirecourt to Metz, 30 miles of 8-in. from Phalsbourg to Deux Ponts, 35 miles of 8-in. from Phalsbourg to Strasbourg.

• **Yacimientos Petroliferos Fiscales** (Argentina).

Project: 497 miles from Mendoza to Buenos Aires.

Status: Proposed.

Foreign Natural-Gas Pipelines

• **Andes Pipeline Corp.** (Subsidiary of Glenn McCarthy, Inc.)

Project: 500 miles of 12-in. from McCarthy's Bolivian concession to the Chile copper-mining area.

Status: Proposed.

Contractor: Will do own work.

• **Attock Oil Co.**

Project: 60 miles of line from Dhulian field to Rawalpindi in West Pakistan.

Status: Planned.

• **Cia. Shell de Venezuela.**

Project: 177 miles of 20-in. from La Paz field in the Maracaibo district, to the Cardon refinery on Paraguana Peninsula, to fuel refinery furnaces.

Status: Under way.

Contractor: **Williams Brothers Co.**

Completion: 1957.

• **Gaz de France**

Project: 550 miles of 16 to 24-in. from Lacq field, southwestern France, to Paris, plus a 10-in. lateral to Nantes and 12 to 16-in. laterals to Lyons, making a 1,000-mile system.

Status: Right-of-way work under way.

Contractor: Being handled by French contractors.

Completion: First stage in 1958; complete system in 1960.

• **Petroleos Mexicanos**

Project: 130 miles of 22-in. to parallel a 14-in. line from Reynosa to Monterrey in northern Mexico.

• **Sui Gas Transmission Co.**

Project: 217 miles of 16-in. from Sui gas field to Moultan, Pakistan.

Status: Under way; to be extended later to Lahore with branches at Kot Addu, Jhang, Magiana, and Montgomery.

Contractors: **Pakistan Constructors,** a joint company of **Morrison-Knudsen** of Boise, Idaho, and **William Press, Ltd.,** of London.

Project: 145-mile line from Sylhet to Dacca, East Pakistan.

Status: Under consideration. If approved construction could start December 1958.

• **Technical Office of Hydrocarbon, Ministry of Mines and Petroleum, Government of Venezuela.**

Project: 207 miles of 26-in. from Anaco fields to Caracas.

Status: Under way.

Contractor: **Fulghum Contracting Corp.** will be consultants; **Petrogas, S. A.** will engineer and construct the line.

Completion: Spring 1959.

Status: Under way.

• **Union of Soviet Socialist Republic.**

Project: 808 miles of 26-in. from Stavropol in the Northern Caucasus to Moscow. The line, larger than Russia's other two major gas lines which are only 16 and 18-in., will serve Voroshilovgrad, Voronezh, Tula, Yelets, and Serpukhov.

• **Yacimientos Petroliferos Fiscales (Argentina)**

Project: 1,056 miles from Campo Duran to Buenos Aires.

Status: Planned.

ADVERTISERS IN THIS ISSUE

ACF Industries, Incorporated
Industrial Products Division 223
Aldrich Pump Company, The 12
Allis-Chalmers, Construction Machinery Division 211
Allis-Chalmers Mfg. Co. 224, 225, 235, 236, 237, 238, 250
American Air Filter Co., Inc. 272
American Cable Division of American Chain & Cable 30
American Manufacturing Co. of Texas 7
American Telephone & Telegraph Co. 262
American Zinc, Lead & Smelting Company 289
Ampco Metal, Inc. 65
Anderson Company, The V. D. 267
Austin-Western Works, Baldwin-Lima-Hamilton 242
Avondale Marine Ways, Inc. 43

Babcock & Wilcox Company—
Tubular Products Division, The 22
Bailey Meter Company 239
Baird Mfg. Co. 302
Bakelite Company
A Division of Union Carbide and Carbon Corporation 152
Baker Oil Tools, Inc. 80
Barton Instrument Corporation 231
Bethlehem Supply Co. 59
Bigelow Co., The 259
Bingham Pump Company 56
Bos-co Equip't Eng'r'g & Mfg. 274
Braun & Co., C F 199, 200, 201, 202
British Petroleum Company Limited, The 144, 145, 148
Burden Construction Corporation, O. R. 263

CF&I Tubular Products, The Colorado Fuel and Iron Corporation 10
Chain Belt Co. 38
Chicago Bridge & Iron Company 214, 215
Chiksan Company 37
Clark Bros. Co., One of the Dresser Industries 32, 33
Classified Advertising 333, 334, 335, 336, 337
Cleveland Trencher Company, The 266
Coates Field Service, Inc. 274
Comptoir Franco-Belge d'exportation des Tubes d'acier 39
Continental-Emsco Company 40
Cooper-Bessemer Corp., The 248, 249
Coppus Engineering Corp. 5
Corrosion Services Incorporated 282
Cosasco Division of Perfect Circle Corporation 15
Crane Co. 129, 206
Crosby Laughlin Division 67
Crose Manufacturing Co., Inc., M. J. 265
Crutcher-Rolfs-Cummings, Inc. 305

Darling Valve and Mfg. Co. 27
Dayton Rubber Co. 268, 269
Dearborn Chemical Company 271
Detroit Controls Corporation, Division of American-Standard 69
Detroit Diesel Engine Division, General Motors Corp. 26
Dowell Incorporated ..... 139, Inside Back Cover
Dresser Industries, Inc. 280, 281
Drilling & Service, Inc. 321
Ducon Company, Inc., The 260
du Pont 28
Duriron Company, Inc., The 293

E-I-M Company Incorporated 150
Electro Rust-Proofing Corp. 258
Elliott Company 218, 219
Engineering Oil Tools, Inc. 20, 21
Esso Research and Engineering Company 207

Farrel-Birmingham Co., Inc. 18
First City National Bank in Houston 261
Fischer & Porter Co. 212
Fish Companies, The 64
Fisher Governor Company 203
Fleet-Line Co. 270
Foster Wheeler Corporation 234

Gardner-Denver Company 82, 83
Girdler Company, The 229
Goodrich Chemical Company, B. F. (Geon) 1
Goodyear Tire & Rubber Company, The 19
Gorman-Rupp Company, The 154
Grancell, I. H. 300
Graver Tank & Mfg. Co., Inc. 36
Gray Concrete Pipe Company, Inc. 259
Grove Valve and Regulator Company 34
Guiberson Corporation 23

H & M Pipe Beveling Machine Co. 277
Halliburton Oil Well Cementing Co. ..... Inside Front Cover, 70, 71
Hercules Tool Company 309
Hill, Hubbell and Company, Division of General Paint Corporation 44
H_2Oil Engineering Corp. 267
Houdry Process Corporation 135
Houston Contracting Company 264
Huey & Co., S. E. 270
Hughes Tool Co. ..... Back Cover

Ideco, one of the Dresser Industries 284, 285
Inferno Co., The 286
Ingersoll-Rand 256, 257
International Business Machine Corporation 147

Jerguson Gage & Valve Company 251
Johns-Manville Corporation 136
Jones & Laughlin Steel Corporation 53
Jones & Laughlin Supply Division 68

Kaiser Aluminum & Chemical Sales, Inc. 29
Kellogg Co., The M. W. 243, 244
Kendall Company, Polyken Sales Division 61
Kinzbach Tool Co., Inc. 289
Koenig Iron Works, Inc. 270

Leland Equipment Co. 74
LimiTorque Corporation 54
Lincoln Electric Company, The 295
Lone Star Cement Corporation 54
Lone Star Constructors 270
Lukens Steel Company 208, 209
Lunkenheimer Co., The 13

M & V Tank Co. 324
Magnet Cove Barium Corp. 57
Manning, Maxwell & Moore, Inc. 204, 205, 232, 233, 254
Martin-Decker Corp. 319
Martin, Manufacturer, John N. 291
McNamar Boiler & Tank Co. 60
Mercoid Corp., The 274
Mexico Refractories Company 210
Mid-Western Industries, Inc. 50
Midwestern Pipe Line Products Company 55
Mission Mfg. Company 75, 76, 77, 78
Mixing Equipment Co., Inc. 246
Moore & Company, Samuel 228
Moorlane Company 283
Moran Furnace & Sheet Metal Co. 252
Mueller Co. 31
Mutual Chemical Division Allied Chemical & Dye Corporation 254

Nash Engineering Co. 222
National Airoil Burner Co., The 247
National Aluminate Corp. 127
National Foam System, Inc. 255
National Supply Co., The 45, 46, 47, 48
National Tank Company 340
Nelson Electric Co. 275
Nordberg Mfg. Co. 8, 9
Norris Manufacturer, Inc., W. C. 4
Northwest Engineering Company 42

Oakite Products, Inc. 307
Oil States Rubber Co. 301
Oil Well Supply Division 6
Onan & Sons, Inc., D. W. 264

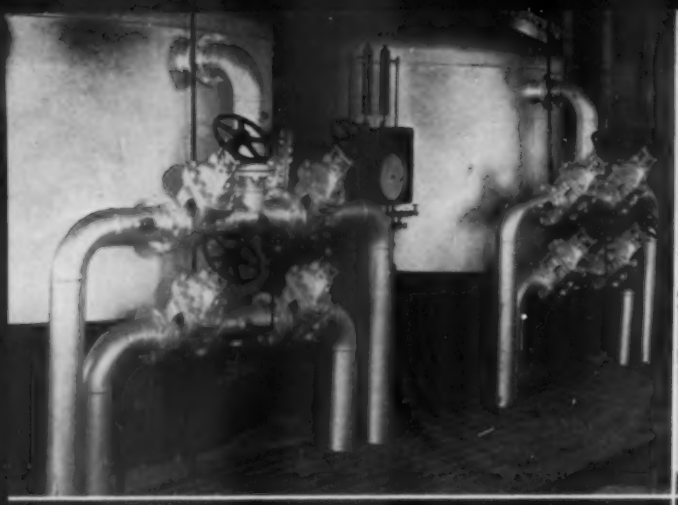
Pacific Pumps, Inc. 245
Paris Distributor, Inc., Henry H. 301
Parkersburg Rig & Reel Co. 130, 131
Peerless Supply Co., Inc. 274
Petreco, A Division of Petrolite Corporation 230
Petroleum Electric Power Assn. 49
Philadelphia Gear Works, Inc. 54
Polyken Sales Division of The Kendall Company 61
Radio Corporation of America 51
Refinery Engineering Company 17
Refinery Supply Co., The 309
Reynolds Metals Company 41
Ridge Tool Company, The 239
River Construction Corporation 278
Rockwood Sprinkler Company 297
Roebling's Sons Company, John A. 58
Rubber & Plastics Compound Co., Inc. 273
Schlumberger Well Surveying Corp. 62, 63
Selas Corporation of America 213
Smith Corporation, A. O.
All Petroleum Products 240, 241
Tubular Products Division 24, 25
Smith Oil Tool Co., H. C. 287
Southern California Oil Tool Company 286
Southern Mill & Mfg. Co. 296
Southland Battery Co. 270, 302, 323
Southwest Industries, Inc. 66
Spencer-Safford Loadcraft, Inc. 52
Taylor Instrument Companies 220, 221
Technical Oil Tool Corporation 73
Tennessee Corporation 265
Texsteam Corporation 323
Thermoid Company 16
Thompson Tank & Manufacturing Co., Inc. 275
Timken Roller Bearing Company 35
Tretolite Company, A Division of Petrolite Corporation 253
Tulsa Winch Division of Vickers Incorporated 308
Twin Disc Clutch Co. 72, 298, 299

Union Carbide and Carbon Corporation, Bakelite Company 152
Union Switch & Signal Division of Westinghouse Air Brake Company 14
United States Steel Corporation—
Oil Well Supply Division 6
United Supply & Manufacturing Co. 292
Universal Atlas Cement Co. 310
Universal Oil Products Co. 225, 227

Waldron Corp., John 279
Walker Co., W. L. 263
Wallace & Tiernan Incorporated 258
Warner Lewis Company 11
Warren Automatic Tool Co. 322
Well Equipment Mfg. Corp. 286
Western Hills Lodge 302
Weston Electrical Instrument Corporation 216
Whitmor Homebuilders, Inc. 306
Wichtex Machinery Company, Inc. 299
Williamson, Inc., T. D. 276
W-K-M Manufacturing Company, Inc., A Subsidiary of ACF Industries, Incorporated 223
York Co., Inc., Otto H. 217
Youngstown Sheet and Tube Company 133

LEGAL

SEALED BIDS will be received until 2:00 P. M., Mountain Standard Time, June 4, 1957, and opened at that time in the Office of the Fort Peck Indian Agency, Poplar, Montana, for the leasing of 37,619.22 acres of tribal and allotted Indian lands, located in Roosevelt, Daniels, Sheridan Counties, Montana, and Williams County, North Dakota, for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of the Fort Peck Indian Agency at Poplar, Montana, or telephone Poplar 2161.



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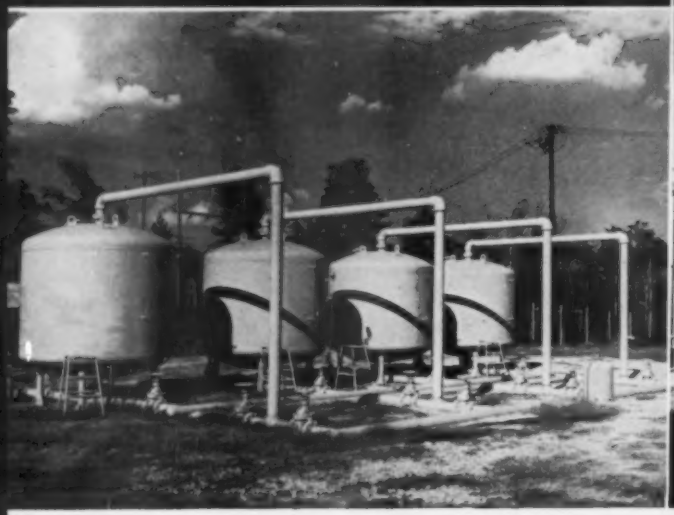

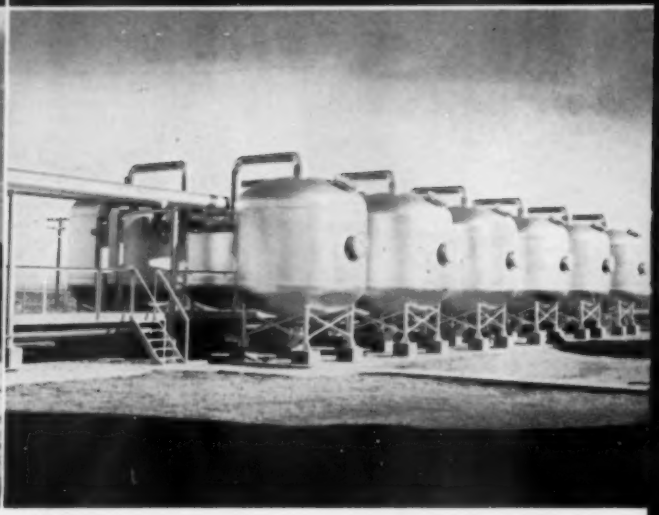

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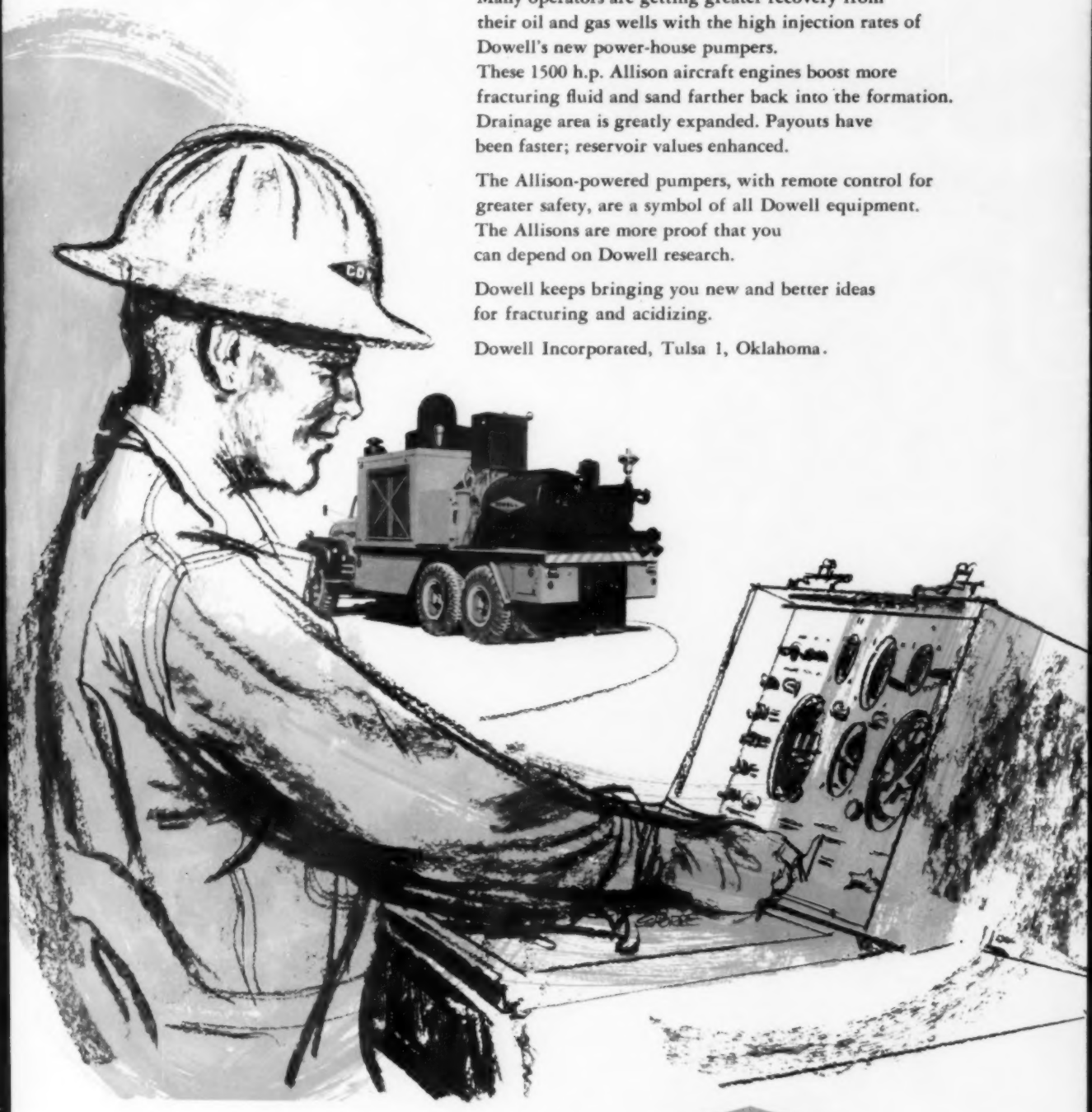

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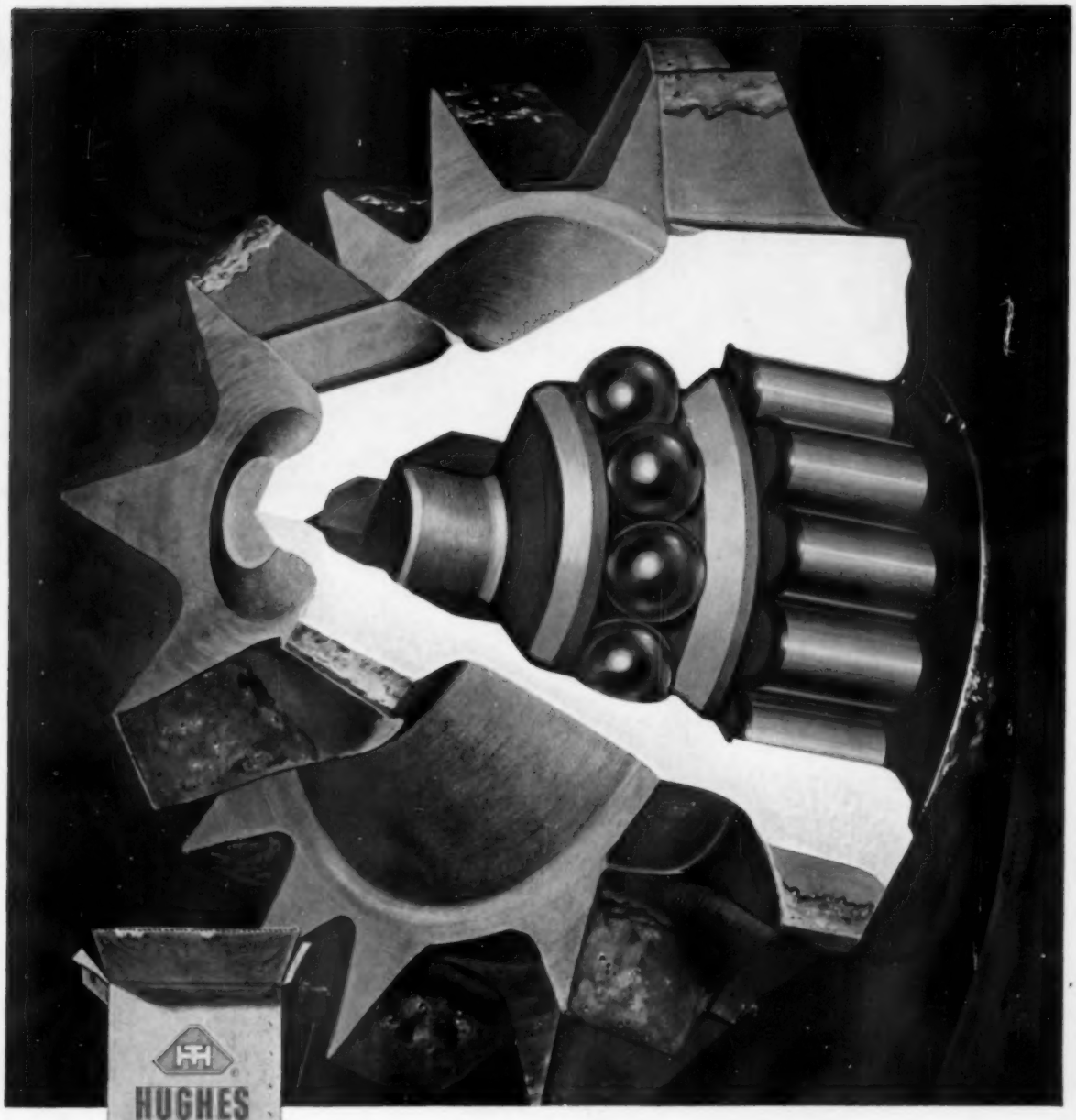

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